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Gypsum Construction Handbook

2nd edition

UNITED STATES GYPSUM

UNITED STATES GYPSUM

101 S. Wacker Drive, Chicago, Ill. 60606

gypsum construction handbook

with Product and Construction Standards

. . . about this handbook

This second edition Gypsum Construction Handbook is a guide to good construction procedures for gypsum drywall, veneer finish and conventional plaster construction. It contains the newest developments in products and systems including time-saving, lower-cost methods of installation to simplify and speed construction. Also included are up-to-date physical test data and information on tools and equipment. The book, which has become a standard handbook in other countries as well as the United States, serves as a valuable reference for those with broad experience in addition to those wishing to learn gypsum construction.

how it serves you

This handbook allows you to find the information you need quickly and easily, for example:

Architects and Engineers—Technical information on gypsum product construction standards, including system descriptions, fire- and sound-rated construction available, limitations and installation procedures.

Contractors, Builders and Dealers—Full data on all aspects of gypsum products and accessories, tools and equipment, and application including information for estimating and planning.

Journeymen—Clear, concise illustrated directions and techniques for applying gypsum products from framing to finish.

Building Inspectors and Code Officials—Fire, sound and physical test data; proper construction procedures for gypsum products to assure compliance with fire and sound ratings.

To find the information you want: Use the fully cross-referenced index in the back. Or—check the Table of Contents on page 3 to find the applicable chapter on drywall and veneer or conventional plaster construction, then use the detailed table on the first page of that chapter to find the specific page. For example, if you want information on drywall metal trim, it's in the index both as "Metal trim, drywall" and "Trim, metal, drywall". Also, the facing Table of Contents shows Product Standards for Drywall and Veneer Construction beginning on page 8, and the contents listing at the start of the chapter shows the page where metal accessories are found.

this is not a technical reference manual

Because products and systems may be improved and changed after this handbook is printed, please refer to current technical literature described in Chapter 9 for the latest fire and sound ratings, thermal and structural data. Consult application directions on the product container for current correct use of the product.

Results from tests are obtained under controlled laboratory conditions per ASTM procedures. Comparable field performance depends on building design and workmanship which may cause variance in job-applied results.

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introduction

Successful Systems for Interior Construction

Gypsum construction today meets the specialized requirements for modern building design and receives wide acceptance in commercial, industrial, institutional and residential construction. Research and development to meet changing needs continues to provide new concepts in products and building systems.

As a leader in this industry, United States Gypsum offers a wide variety of quality products and performance-engineered systems. These systems are designed to consider all major factors: cost, sound control, fire resistance, structural capacity, esthetics and overall utility and function. Thin, lightweight gypsum panel drywall assemblies—noted for their fast installation and low cost—are used in the majority of new residential buildings and have gained similar acceptance in commercial buildings. High-strength, fast-drying veneer finishes are economically applied to large-size gypsum base to form damage-resistant, easily decorated surfaces. Impact- and crack-resistant conventional gypsum plaster systems with high structural integrity and durability provide attractive joint-free walls and ceilings whether in plane or free-flowing contoured surfaces.

SHEETROCK Brand Gypsum Panels, IMPERIAL Gypsum Bases, ROCKLATH Plaster Bases and RED TOP Plasters have their beginning in the ground as a gray to white-colored rock called gypsum. The basic ingredient of these fire-resistant products, gypsum, is a mineral composed of calcium sulfate chemically combined with water of crystallization—$CaSO_4 2H_2O$. The combined water makes up approximately 20% of the weight of gypsum rock. This feature gives gypsum its fire-resistive qualities and makes it so adaptable for construction purposes.

After gypsum rock is mined or quarried, it is crushed, dried, and ground to flour fineness, then calcined to drive off the greater part of the chemically combined water as steam. This calcined gypsum, commonly called Plaster of Paris, is then specially formulated with other ingredients and bagged for shipment as gypsum plaster or mixed with water and other materials and sandwiched between two sheets of specially manufactured paper to form various types of gypsum boards. After the gypsum core has set, the boards, which are formed in a highly automated continuous process, are cut to length, dried, prefinished if required, and packaged for shipment. All processing is in strict accordance with specifications to meet quality standards.

The continued growth of gypsum construction depends on maintaining quality while reducing construction time and costs. U.S.G. has consistently been in the forefront of this effort. Strategically located operating plants produce and/or stock the building materials described here—all part of a coordinated system of components required for complete systems. Products include gypsum base and panels, steel products, joint treatment materials and veneer or standard plaster finishes, plus finish

trims and paints. At the U.S.G. Research Center, new products for broader uses and new cost-saving systems with improved fire and sound resistance are continually being developed.

These new and improved products and systems are released only after thorough testing and field trial. Manufacture of these products to carefully controlled standards insures uniform quality. Evidence of this is the preference for U.S.G.'s products in the marketplace.

Advantages of Gypsum Construction

Fire Resistance—Gypsum will not support combustion. When attacked by fire, water of crystallization is released and turns to steam to help retard the spread of flame to protect adjacent constructions. Gypsum construction meets fire resistance and flame spread requirements of all model building codes. Fire resistance ratings up to 4 hrs. are available with specific partition, wall, floor-ceiling and column fireproofing assemblies.

Sound Control—Gypsum construction offers excellent resistance to airborne and impact sound transmission without excessive bulk or weight. Resilient attachment of gypsum panels or bases further improves sound ratings, makes partitions ideally suited for party walls. Walls and floor-ceiling assemblies are available which meet STC and IIC requirements of HUD/FHA, building codes, and tenant/owner needs.

Durability—The high-strength and abrasion-resistant features of veneer finishes offer durability needed in high-traffic areas. Conventional plaster surfaces have high structural integrity and are resistant to impact and abuse. Bonded together with a U.S.G. Joint System, gypsum panels form walls and ceilings that are resistant to cracks caused by minor structural movement as well as variations in temperature and humidity.

Light Weight—Gypsum partition systems weigh appreciably less than masonry assemblies of the same thickness. They reduce material-handling expense and may permit the use of lighter structural members, floors and footings. Veneer construction compares with the weight of gypsum drywall and is considerably lighter than conventional plaster.

Low Installed Cost—Gypsum systems provide lower installed costs than more massive constructions. The lighter weight systems reduce materials-handling costs. The hollow-type constructions provide an ample cavity for thermal and sound insulation, simplifying fixture attachment and mechanical installation. Low material cost and large, quickly erected panels combine to provide a lower cost for gypsum drywall and veneer systems than conventional plaster. Fast veneer finish application plus savings in decorating time make veneer systems competitive to gypsum drywall in many instances.

Speedy Installation—Gypsum construction is fast, eliminates costly winter construction delays, permits earlier completion and occupancy of buildings. Gypsum panels and bases are job-stocked ready for use, easily cut and quickly applied. For

high-volume applications, conventional plasters are readily pumped and spray-applied. Veneer plasters, which set in approx. one hour, eliminate drying delays and are usually ready for next-day decorating or painting with breather-type paints.

Easily Decorated—Gypsum construction offers smooth surfaces that readily accept decoration with paint, wallpaper, vinyl coverings or wall tile and permit repeated decoration throughout the life of the building. Plain or aggregated textures are easily applied to gypsum panels or produced during finish coat plastering. With durable, vinyl-faced TEXTONE Gypsum Panels, joint finishing and decorating are eliminated, maintenance is minimized. The smooth, hard surfaces obtained with veneer finishes and conventional plasters are more sanitary and easier to maintain than exposed concrete block.

Versatility—Suitable as divider, corridor and party walls; pipe chase and shaft enclosures; radiant-heat ceilings; exterior walls and wall furring; membrane fire-resistant constructions. Adaptable for use in every type of new construction—commercial, institutional, industrial and residential—and in remodeling. Produce attractive joint-free walls and ceilings; easily adapt to most contours, modules and dimensions.

Dramatic shopping mall ceiling is constructed of drywall, finished to blend with plaster walls and concrete columns.

chapter 1

drywall and veneer construction

product standards

quality products for gypsum construction

Since their introduction over 60 years ago, SHEETROCK Brand Gypsum Panels have dominated the drywall revolution and become the byword for quality interior walls and ceilings. With the addition of veneer bases and hard surface finishes, United States Gypsum has the nation's largest-selling, broadest line of gypsum products—No. 1 in quality and performance.

The drywall and veneer finish products described in this chapter conform to product standards recommended by United States Gypsum Company and most applicable Government and Commercial Standards. These materials meet the essential requirements of economy, sound isolation, workability, strength, fire resistance, and ease of decoration which are characteristic of quality construction.

Sales and technical representatives are employed by U.S.G. to consult with tradesmen, contractors, architects, dealers and code officials on gypsum products and systems and their application to individual job problems and conditions. They may be reached through the nearest U.S.G. sales office or by directing inquiries to United States Gypsum General Offices, 101 S. Wacker Dr., Chicago, Ill. 60606, phone: (312) 321-4000.

Gypsum Panel Products

SHEETROCK is still the preferred and most widely used brand of gypsum panels in existence. These panels are available in more specialized forms than any other gypsum panel line. Its high quality standards extend to a complete line of U.S.G. components, designed to provide high-performance walls and ceilings. Thus, one dependable source offers unit responsibility for the system used.

The SHEETROCK Brand Panel is a factory-produced, 4-ft. wide panel composed of a noncombustible gypsum core encased in a heavy natural-finish paper on the face side and a strong liner paper on the back side. The face paper is folded around the long edges to reinforce and protect the core, and the ends are square-cut and finished smooth. Long edges of panels are tapered, allowing joints to be reinforced and concealed with a U.S.G. joint treatment system.

advantages

Interior walls and ceilings built with SHEETROCK Brand Panels have a durable surface suitable for most types of decorative treatment and for redecoration during the life of the building.

Dry Construction—Factory-produced panels do not contribute moisture in construction.

Fire Protection—The gypsum core will not support combustion or transmit temperatures greatly in excess of 212°F. until completely calcined. Fire-resistance ratings of up to 4 hours for partitions, 3 hours for floor-ceilings and 4 hours for column and

shaft fireproofing assemblies are available with specific assemblies. See Chapter 3 for specific ratings and related assemblies.

Sound Control—SHEETROCK Brand Gypsum Panels are a vital component in sound-resistive partition and floor-ceiling systems. (See Chapter 3 for specific rating data.)

Low In-place Cost—The easily-cut gypsum panels apply quickly. Fixture attachment and installation of electrical and mechanical services are simplified.

Dimensional Stability—Expansion or contraction under normal temperature and humidity changes is small and normally will not result in warping or buckling. With joints properly reinforced, SHEETROCK Brand Panels are exceptionally resistant to cracking caused by internal or external forces. See Appendix for thermal and hygrometric coefficients of expansion.

Availability—More than 20 strategically located U.S.G. manufacturing plants produce gypsum board products described here. Special warehouse facilities, in addition to these plants, increase total distribution and service efficiency to major markets and rural areas from coast to coast. All standard gypsum board products are readily available upon short notice. Certain products are available from plants in Mexico and Canada.

general limitations

1. Exposure to excessive or continuous moisture and extreme temperatures should be avoided. Not recommended for use in solar systems when board will be in direct contact with surfaces exceeding 125°F.

2. Must be adequately protected against wetting when used as a base for ceramic or other wall tile (see foil-back panel limitation). SHEETROCK Brand W/R Gypsum Panels are the recommended product for this purpose in partitions.

3. Maximum spacing of framing members:½″ and ⅝″ gypsum panels are designed for use on framing centers from 16″ to 24″; ⅜″ and ¼″ panels, on centers up to 16″. In both walls and ceilings, when ½″ or ⅝″ gypsum panels are applied across framing on 24″ centers and joints reinforced, headers are not required. ⅜″ and ¼″ SHEETROCK Brand Panels not recommended for use on steel framing nor as base for water-based texturing materials. For this finish, ½″ or ⅝″ gypsum panels are applied across framing. (For specific requirements and limitations, see Chapter 2.)

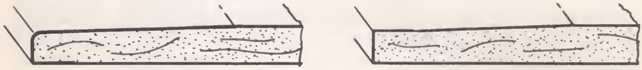
4. Application of SHEETROCK Brand Panels over ¾″ wood furring applied across framing is not recommended since the flexibility of the furring under impact of the hammer tends to loosen nails already driven. Furring should be 2″x2″ minimum (may be nom. 1″x4″ if panels are to be screw-attached).

5. The application of gypsum panels over an insulating blanket, that has first been installed continuously across the face of the framing members, is not recommended. Blankets should be recessed and flanges attached to sides of studs or joists.

6. To prevent objectionable sag in new gypsum panel ceilings,

the weight of overlaid unsupported insulation should not exceed 1.3 psf for ½″ thick panels with frame spacing 24″ o.c.; 2.2 psf for ½″ panels on 16″ o.c. framing and ⅝″ panels 24″ o.c.; ⅜″ thick panels must not be overlaid with unsupported insulation. A vapor retarder should be installed in all exterior ceilings, and the plenum or attic space properly vented. In winter or cold climates, a polyethylene vapor retarder should not be used unless the insulation is installed prior to ceiling panels.

Types of Tapered Edges



products available

SHEETROCK Brand Regular Gypsum Panels—Have long edges tapered on the face side to form a shallow recess (nom. .050″ deep) to accommodate joint reinforcement. Made in four thicknesses for specific purposes:

—⅝″, recommended for the finest single-layer drywall construction. The greater thickness provides increased resistance to fire exposure, transmission of sound, and sagging.

—½″, for single-layer application in typical new construction.

—⅜″, lightweight, applied principally in repair and remodel work over existing surfaces.

—¼″, a lightweight, low-cost, utility gypsum panel, used as a base layer for improving sound control in multilayer partitions and in covering old wall and ceiling surfaces. Also for forming curved surfaces with short radii.

SHEETROCK Brand SW Gypsum Panels—Have an exclusive tapered rounded edge design to help minimize ridging or beading and other joint imperfections. This edge produces a much stronger joint than regular tapered edge when finished with joint treatment. Except for the rounded edge, panels are tapered like, and otherwise identical to, regular tapered-edge gypsum panels. Made in ⅝″, ½″ and ⅜″ thicknesses.

SHEETROCK Brand FIRECODE Gypsum Panels—⅝″ thick, combine all the advantages of regular panels with additional resistance to fire exposure—the result of a specially formulated core containing special additives that enhance the integrity of the core under fire exposure. Panels comply with ASTM C36 for Type X gypsum board.

SHEETROCK Brand FIRECODE "C" Gypsum Panels—Available in ½″ and ⅝″ thicknesses. Based on tests at Underwriters Laboratories Inc. and other nationally recognized testing agencies, certain partition, floor-ceiling, and column fire-protective assemblies using these special products provide 1-hour to

4-hour fire-resistance ratings. These products are used in 3-hour floor and ceiling and up to 4-hour partition and column fireproofing constructions (see Chapter 3).

In order to attain fire-resistance ratings, the construction of all such assemblies must be identical to the assembly tested. (See Chapter 3—System Installation, for fire-rated systems.)

Foil-Back Gypsum Panels—Made by laminating special kraft-backed aluminum foil to back surface of regular, SW, FIRECODE or FIRECODE "C" Panels. Effective as a vapor retarder for walls and ceilings when applied with foil surface next to the framing (1) in single-layer application, or (2) as the base layer in multi-layer systems. Foil-Back Gypsum Panels provide a water vapor retarder to help prevent interior moisture from entering wall and ceiling spaces. In tests per ASTM C355 (desiccant method), ½" foil-back panels showed a vapor permeance of 0.06 perm.

These panels are designed for use with furred masonry, wood or steel framing, except in air conditioned buildings in climates having sustained high outside temperature and humidity. Under these conditions, a qualified mechanical engineer should determine vapor retarder location.

In addition, foil-back panels have an emittance value of 0.05. Use this value in conjunction with the ASHRAE Handbook of Fundamentals for determining the thermal insulation value of a system when the foil faces a plane air space of ½" to 3½".

Limitations: Not recommended as a base for ceramic or other

Foil-Back Panels applied to Z-Furring Channels over exterior masonry walls provide effective vapor retarder.

tile or as base layer for TEXTONE Panels in double-layer assemblies. Also not to be used as a base for highly moisture-resistant wall coverings in hot, humid climates such as the Southern Atlantic and Gulf Coast areas.

SHEETROCK Brand W/R Gypsum Panels—A proven water-resistant base for the adhesive application of ceramic and plastic tile and plastic-faced wall panels. Made water-resistant all the way through: (1) multilayered face and back paper are chemically treated to combat penetration of moisture; (2) the gypsum core is made water-resistant with a special asphalt composition. The panel is easily recognized because of its distinctive green face.

These panels are designed for bathrooms, powder rooms, kitchens, utility rooms. In addition, they may be used in modernization work when the existing surfaces are removed and W/R Panels applied directly to framing. SHEETROCK Brand W/R FIRECODE "C" Panels also are used in fire-resistant USG Area Separation Walls between apartment and townhouse units, and other fire-rated assemblies that may be exposed to moisture during construction.

Limitations: adherence to recommendations concerning sealing exposed edges, painting, tile adhesives, framing and installation is necessary for satisfactory performance (see Chapter 2). Not recommended for ceilings, for resilient attachment where tile is to be applied or in remodeling unless applied directly to studs. Panels should not be installed over a vapor retarder nor on a wall acting as a vapor retarder.

Available in regular core, ½" and ⅝" thickness; also in ½" and ⅝" SHEETROCK Brand W/R FIRECODE "C" Panels for application where a fire rating is desired—listed by Underwriters Laboratories Inc. Panels comply with ASTM C630 and Federal Specification SS-L-30D.

SHEETROCK Brand W/R Compound—Applied to all raw cut edges; treat joints and nailheads of SHEETROCK Brand W/R Gypsum Panels—thus protecting the gypsum core from moisture penetration. Packaged in quart and gallon containers for fast, easy application.

USG Exterior Gypsum Ceiling Board—A weather-resistant board designed for use on the soffit side of eaves, canopies and carports and other commercial and residential exterior applications with indirect exposure to the weather. Core is noncombustible, is simply scored and snapped for quick application. Panels can be painted and provide good sag resistance.

Installed conventionally in wood- and metal-framed soffits; batten strips or mouldings used over butt joints or joints treated; backing strips required for small vent openings. Has beige water-repellent face paper. Available in ½" thickness with regular core and in ⅝" thick FIRECODE Exterior Ceiling Board with fire-rated core—both with eased edges. Board complies with ASTM C931.

Specifications—Gypsum Panel Products

	thickness		length ft[1]	approx. wt.	
	in	mm		lb/ft²	kg/m²
SHEETROCK Brand Regular Panels[2]	¼	6.4	8 and 10	1.2	5.9
	⅜	9.5	8, 9, 10, 12, 14	1.4	6.8
	½	12.7		1.8	8.8
	⅝	15.9		2.3	11.2
FIRECODE Panels[2]	⅝	15.9	8, 9, 10, 12, 14	2.3	11.2
FIRECODE "C" Panels[2]	½	12.7	8, 9, 10, 12, 14	2.0	9.8
	⅝	15.9		2.5	12.2
W/R Regular Panels	½	12.7	8, 10, 12	2.0	9.8
	⅝	15.9		2.4	11.7
W/R FIRECODE "C" Panels	½	12.7	10	2.0	9.8
	⅝	15.9	8, 10, 12	2.5	12.2
Exterior Ceiling Board Regular Board	½	12.7	8, 12	1.9	9.3
	⅝	15.9		2.4	11.7
FIRECODE Board	⅝	15.9		2.4	11.7

[1] Metric lengths: 8 ft. = 2440mm; 9 ft. = 2745mm; 10 ft. = 3050mm; 12 ft. = 3660mm; 14 ft. = 4270mm. [2] Also available in Foil-Back Panels.

Predecorated Panel Products

TEXTONE Gypsum Panels are conventional gypsum board with factory-applied vinyl facings in a wide range of coordinated decorator colors. The facings provide a broad choice of color, texture and pattern for mix-and-match versatility. The tough vinyl covering is durable and easily cleaned. Panels have beveled long edges which form a shallow V-groove joint.

TEXTONE Panels and Mouldings, together with fasteners and other conventional drywall components, are used for predecorated permanent partitions, demountable partitions and in remodeling work. Not recommended for ceilings because end joints are difficult to conceal.

The rugged, scuff-resistant vinyl is deeply embossed for texture and woodgrain effects.

limitations

1. For adhesive application of TEXTONE Panels, only water-based adhesives are recommended. Other adhesives may not be compatible and could result in delamination and discoloration of vinyl surface.

2. If TEXTONE FIRECODE Panels are used in a fire-rated assembly, instead of SHEETROCK Brand FIRECODE Panels, the applicable fire test must permit exposed joints or battens. Type of adhesive usually is limited to DURABOND Joint Compound-210 or 90.

3. Not recommended for use over foil-back panels in exterior walls.

4. Avoid exposure to excessive or continuous moisture and extreme temperatures.

Specifications—TEXTONE Vinyl Patterns

TEXTONE pattern	film thickness		backing	vinyl weight (avg.)		vinyl thickness(1) (avg.)	
	mil	mm		oz/yd²	g/m²	in.	mm
Pumices	6	0.15	unbacked	6.6	220	.014	0.36
Suedes	6	0.15	unbacked	6.6	220	.009	0.23
Sandalwoods	5	0.13	unbacked	5.5	185	.007	0.18
Woodgrains	6	0.15	unbacked	6.6	220	.007	0.18
Corks	6	0.15	unbacked	6.65	225	.010	0.25
Linens	8	0.20	unbacked	8.2	280	.016	0.41
Textiles(2)	8	0.20	1.2-oz. poly/ cotton sheeting	9.9	335	.020	0.51

(1) Average overall vinyl film thickness varies with depth of embossing.
(2) Total weight is 11.1 oz./yd.² avg.

technical data

TEXTONE Panels comply with Federal Specification SS-L-30D, Type III; base panels, ASTM C36. Textile pattern vinyl coverings comply with Federal Specification CCC-W-408A, Type I. Light-reflectance values available on request. (Refer to Appendix for Surface Burning Characteristics.)

Specifications: see current U.S.G. Technical Folder SA-928 for pattern and color selections. Panels are manufactured ½″ thick, 4 ft. wide, and 8, 9 and 10 ft. long. They may also be specially ordered in ⅜″ and ⅝″ thicknesses, 2-ft. widths and custom lengths from 6 to 14 ft. TEXTONE FIRECODE Panels with special core for fire-rated construction are available in ½″ and ⅝″ thicknesses, 4 ft. wide.

TEXTONE Vinyl Wallcovering—Supported film 54″ wide, with 1.4 oz. per sq. yd. cotton-sheet backing, is offered separately in limited quantities to provide a commercial match with TEXTONE Panel colors and textures on adjacent walls and columns. Available in rolls of 30 lin. yds.

TEXTONE Mouldings—Cover joints and edges, protect corners. Available to match or contrast with TEXTONE Panels in ½″ and ⅝″ sizes are low-cost, precision-extruded vinyl plastic mouldings in four shapes and two finishes—factory-laminated vinyl (RPV series) and solid colors: ivory, tan, chocolate, black (RP series). Also available is AV-46 in matching factory-laminated vinyl as a ceiling drive-in trim.

Specifications—TEXTONE Mouldings

product	size in[1]	length ft[1]	approx. wt. lb/1000 ft	approx. wt. kg/100m
RP-2, RPV-2 Inside Corner	½, ⅝	8, 9, 10	155, 190	23.1, 28.3
RP-4, RPV-4 End Cap	½, ⅝	8, 9, 10	155, 190	23.1, 28.3
RP-5, RPV-5 Snap-on Corner	[2]	8, 9, 10	440	65.5
RP-7, RPV-7 Snap-on Batten	[2]	8, 9, 10	190	28.3
AV-46 Ceiling Drive-in Trim	½	12	155	23.1

[1] Metric conversions: ½ in. = 12.7 mm; ⅝ in. = 15.9 mm—8 ft. = 2440 mm; 9 ft. = 2745 mm; 10 ft. = 3050 mm; 12 ft. = 3660 mm. [2] One size fits all panel thicknesses.

Gypsum Base Products

Gypsum bases finished with veneer finishes are recommended for interior walls and ceilings in all types of construction. For these interiors, a veneer (1⁄16″ to 3⁄32″ thick) of specially formulated gypsum finish is applied in one or two coats over the base. The resulting smooth or textured monolithic surfaces are preferred for hard-wear locations where durability and resistance to abrasion are required.

IMPERIAL and USG R.H. (Radiant Heat) Base are large-size gypsum board products (4-ft. width), rigid and fire-resistant, for low-cost application of veneer finishes. A gypsum core is faced with specially treated, multilayered paper designed to provide a maximum bond to veneer finishes. The paper's absorbent outer layers quickly and uniformly draw moisture from the veneer finish for proper application and finishing; the moisture-resistant inner layers keep the core dry and rigid to resist sagging. The face paper is folded around the long edges. Ends are square-cut and finished smooth.

Type of Edge

Square

advantages

Gypsum bases, in conjunction with selected veneer finishes, provide the lasting beauty of plaster walls and ceilings at a lower cost and with less weight and residual moisture than conventional plastering.

Rapid Installation—Construction schedules are shortened. Walls and ceilings can be completed in 3 to 4 days, from bare framing through decorated interiors.

Fire Resistance—Ratings of up to 4 hours for partitions, 3 hours

for floor-ceilings and 4 hours for column fire protection assemblies have been obtained. (See Chapter 3 for specific ratings and related construction.)

Sound Control—Gypsum base partitions faced with veneer finishes on both sides have high resistance to sound transmission. Resilient attachment of base and use of THERMAFIBER Blankets further improve sound isolation.

Durability—Hard, high-strength surfaces provide excellent abrasion resistance resulting in minimum maintenance, even in high-traffic areas.

Easily Decorated—Smooth-surfaced interiors readily accept paints, texture, fabric and wallpaper. Veneer finishes also may be textured. Finishes can be painted with breather-type paints the day following application.

general limitations

1. Maximum frame and fastener spacing is dependent on thickness and type of base used. (Refer to appropriate system in Chapter 3 for details.)

2. Recommended for use with IMPERIAL Basecoat and Finish Plasters and DIAMOND Interior Finish. Do not apply gauged lime-putty finishes direct to base or portland cement plaster; bond failure is likely.

3. Not recommended for use in areas exposed to excessive moisture for extended periods or as a base for adhesive application of ceramic tile in wet areas (SHEETROCK Brand W/R Gypsum Panels are recommended for this use).

4. Gypsum base that has faded from the original light blue color from exposure to sunlight should be treated with either a plaster bonding agent or spray-applied alum solution before DIAMOND Interior Finish or any veneer finish containing lime is applied.

products available

IMPERIAL Gypsum Base—A special gypsum board that has been specifically engineered for use with IMPERIAL Finishes and DIAMOND Interior Finish. It provides the strength and absorption characteristics necessary for top-quality veneer finishing performance. Large sheets minimize the number of joints and speed installation. The high-density, fire-resistant gypsum core has a superior controlled-absorption paper lightly tinted blue on the face side and a strong liner paper on the back side. Available in two thicknesses—both with square edges: ½″, for single-layer application in new light construction; ⅝″, recommended for the finest high-strength veneer finish construction. The greater thickness provides increased resistance to fire exposure and sound transmission and allows 24″ o.c. spacing of wood framing. (Refer to frame spacing table in Chapter 2 for limitations.)

IMPERIAL FIRECODE "C" Gypsum Base—½″ and ⅝″ thick-

nesses, and IMPERIAL FIRECODE in ⅝″ thickness combine all the advantages of Regular IMPERIAL Gypsum Base with additional resistance to fire exposure—the result of specially formulated mineral cores. Listed under UL Label Service for certain fire-tested partition, floor-ceiling and column constructions (see Chapter 3 for details).

Foil-Back IMPERIAL Gypsum Bases—Bright aluminum foil laminated to the back side acts as a vapor retarder. Available in Regular, FIRECODE and FIRECODE "C" Bases.

Limitation: do not use as a base for ceramic or other tile or as a face layer in multilayer systems.

USG R.H. Base—A large-size gypsum base with blue face paper used with sanded DIAMOND Interior Finish in electric cable ceilings. A specially formulated gypsum core makes the base resistant to heat deterioration at sustained temperatures up to 150°F. Bases with regular cores will start to deteriorate slowly at 125°F. Most electric-heat cables will exceed the 125°F. temperature, resulting in plaster cracking and deterioration of the base.

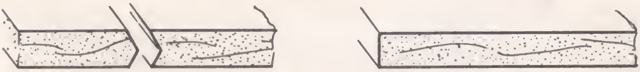
USG R.H. Base is suitable for direct nail or screw application to wood joists, and for screw attachment to metal furring channels and RC-1 Resilient Channels. Joints are reinforced with IMPERIAL Glass Fiber Tape before heating cable is attached.

Specifications—Gypsum Bases

product	thickness		length ft[1]	approx. wt.	
	in	mm		lb/ft²	kg/m²
IMPERIAL Base[2]					
Regular	½	12.7	8, 9, 10,	1.8	8.8
Regular	⅝	15.9	12, 14	2.3	11.2
FIRECODE	⅝	15.9		2.3	11.2
FIRECODE "C"	½	12.7		2.0	9.8
FIRECODE "C"	⅝	15.9		2.5	12.2
USG R.H. Base					
Regular	½	12.7	8, 9, 10,	1.8	8.8
Regular	⅝	15.9	12, 14	2.4	11.7
FIRECODE "C"	½	12.7		2.0	9.8
FIRECODE	⅝	15.9		2.4	11.7

[1] Metric lengths: 8 ft. = 2440 mm; 9 ft. = 2745 mm; 10 ft. = 3050 mm; 12 ft. = 3660 mm; 14 ft. = 4270 mm. [2] Also available in Foil-Back Base.

Coreboard and Sheathing Products



V—T&G Square

Types of Edges

USG Gypsum Coreboard—A 1″ thick gypsum core encased in strong liner paper on both sides. It is used in vent shaft and laminated gypsum partitions with additional layers of gypsum

panels applied to the coreboard to complete the wall assembly. Manufactured with "V" T&G edges for use in solid partitions or with square edges and prescored 6″ or 8″ o.c. for use in semi-solid partitions. Coreboard strips are then easily snapped and separated from this coreboard panel. Coreboard complies with Federal Specification SS-L-30D, Type IV; ASTM C442.

USG Gypsum Liner Panels—A 1″ thick, special fire-resistant gypsum core encased in multilayered, moisture-resistant green paper. They are used in USG Cavity Shaft Walls, Area Separation Walls and Infill Panel Systems for exterior curtain walls. Panels have square edges modified for easy insertion between supporting flanges of steel C-H studs, E-studs or H-studs. Panels comply with Federal Specification SS-L-30D, Type IV; ASTM C442.

Limitation: not recommended for areas exposed to excessive moisture for extended periods of time.

USG Gypsum Sheathing—A fire-resistant gypsum board, ½″ thick, with a water-resistant gypsum core encased in specially treated brown water-repellent paper on both sides and long edges. Its weather resistance, water repellence, fire resistance and low applied cost make it suitable for use in exterior wall construction of garden apartments and light commercial buildings as well as in homes. Also used in steel stud curtain wall construction.

USG Gypsum Sheathing is suitable for a wide range of exterior finishes such as, but not limited to, masonry veneer, wood, vinyl and aluminum siding, wood shingles, and stucco—exterior finish attachment is limited to mechanical fastening through sheathing into the framing. Also used as an economical utility siding for temporary buildings not needing a decorative exterior finish. More than a one-half century of use on millions of buildings proves the lasting quality of USG Gypsum Sheathing.

Available 24″ wide, with V-shaped T&G long edges, normally applied horizontally with tongue up; 48″ wide, with square edges, applied vertically.

limitations

1. Sheathing may be stored outside for up to one month, but must be stored off the ground and must have a protective covering.

2. Maximum stud spacing is 24 in. o.c.

3. When applied to a structure, sheathing must not be left exposed to the elements for more than one month unless the procedure as outlined in limitation 6 (below) is followed.

4. Exterior finish systems must be properly caulked for the life of the job, particularly around all cuts.

5. Exterior finish systems applied over gypsum sheathing must be applied with mechanical fasteners through the sheathing into

the wall framing. Alternate methods of application are not endorsed and their performance is solely the responsibility of the party making the recommendation.

6. For curtain wall construction apply sealant around sheathing perimeter at interface with other materials and install flashing. Then, it is recommended that all gypsum sheathing be covered with No. 15 asphalt felt to assure watertight construction. Asphalt felt should be applied horizontally with 2″ overlap and attached to sheathing. (See SA-805 for additional curtain wall details.)

7. Use of sheathing for exterior ceilings and soffits is not recommended.

Technical Data: USG Gypsum Sheathing complies with Federal Specification SS-L-30D, Type II, Grade W, Class 2; ASTM C79. (See Appendix for permeance and thermal resistance.)

USG Triple-Sealed Gypsum Sheathing—Weather- and fire-resistant, Triple-Sealed Sheathing is specially designed to combine good performance with exceptional economy. Used in wood-frame construction under many exterior finishes such as, but not limited to, masonry veneer, wood siding and shingles, stucco and composition siding. Also used in steel stud curtain wall construction. Noncombustible gypsum core adds fire resistance not available with plywood or wood-fiber sheathing.

Clad in water-repellent paper on face, back and long edges; ends are coated with special waterproofing compound. Panels are water-resistant, not totally waterproof, and will require some weather protection or inside storage in wet regions or during extended rainy periods. Must be properly supported and protected from standing water. Lightweight and easily handled by one man, cut quickly by scoring and snapping. Attach with a minimum of fasteners.

Triple-Sealed Sheathing is the most economical structural sheathing on the market.

Limitations: Same as for USG Gypsum Sheathing shown on page 20.

Specifications—Coreboard & Sheathing Products

product	thickness		width		edges	length	approx. wt.	
	in	mm	in	mm		ft	lb/ft²	kg/m²
Coreboard	1	25.4	16 24	406 610	V—T&G	8, 9, 10, 12[1]	4.1	20.0
Liner Panels	1	25.4	16 24	406 610	Bev.	up to 16	4.1	20.0
USG Gypsum Sheathing	½	12.7	24 48	610 1219	T&G Sq.	8 8, 9	2.0 2.0	9.8 9.8
Triple-Sealed Sheathing	4/10	10.2	48	1219	Sq.	8, 9	1.6	7.8

[1] Prescored coreboards available in 7′-8″ lengths only.

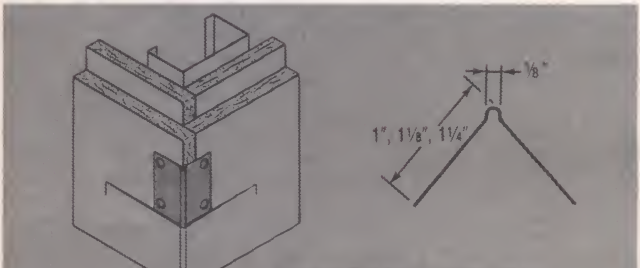
Trim Accessories

U.S.G. accessories include corner reinforcements, beads, trims, control joints and decorative mouldings.

corner reinforcement

USG Corner Beads permit construction of true, concealed external angles with gypsum base and panels. The exposed nose of the bead helps prevent damage from impact and provides a screed for finishing. Offered in three versions:

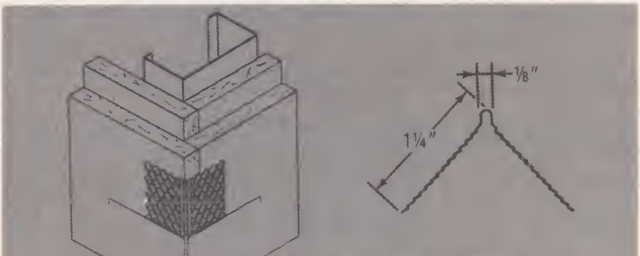
DUR-A-BEAD Corner Bead—A specially galvanized steel reinforcement for protecting external corners in drywall construction. It is screwed or nailed to framing through the panels and concealed with U.S.G. joint compounds as a smooth, finished corner. Flanges also may be attached with clinch-on tool. Available in three flange widths: **No. 101** 1″×1″, **No. 103** 1¼″×1¼″, **No. 104** 1⅛″×1⅛″.



DUR-A-BEAD Corner Bead

No. 800 Corner Bead—A galvanized steel external corner reinforcement with 1¼″ wide fine-mesh expanded flanges, tapered along outer edges to enhance concealment. It is easily nailed or stapled. Provides superior bond to panels and base with joint compound and veneer finishes through approx. 90 keys per lin. ft. It also provides the proper 1⁄16″ grounds for one-coat veneer finishes.

No. 900 Corner Bead—Used with two-coat veneer systems. It



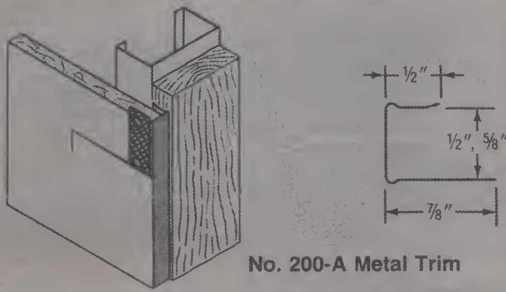
Nos. 800 & 900 Corner Bead

provides 3/32" grounds and its 1¼" fine-mesh flanges can be either stapled or nailed. Provides bond equivalent to No. 800.

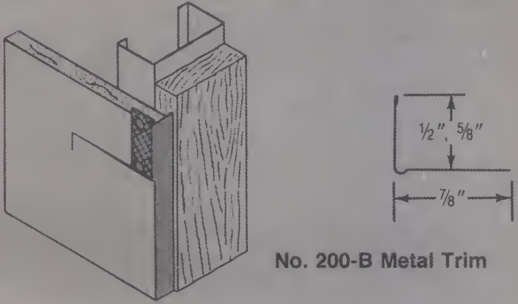
metal trim

USG Metal Trims provide maximum protection and neat finished edges to gypsum panels and bases at window and door jambs, at internal angles and at intersections where panels abut other materials. Easily installed by nailing or screwing through the proper leg of trim. Made in following types and sizes:

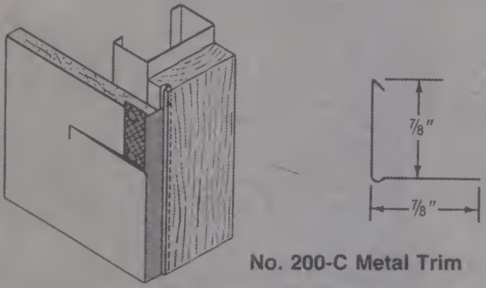
No. 200 series—Galvanized steel casing for gypsum panels, includes **No. 200-A** U-shaped channel in ½" and ⅝" sizes; **No. 200-B** L-shaped angle edge trim without back flange to simplify application, in ½" and ⅝" sizes; **No. 200-C** L-shaped trim, requires slotted jamb for installation in most cases, open "V"



No. 200-A Metal Trim



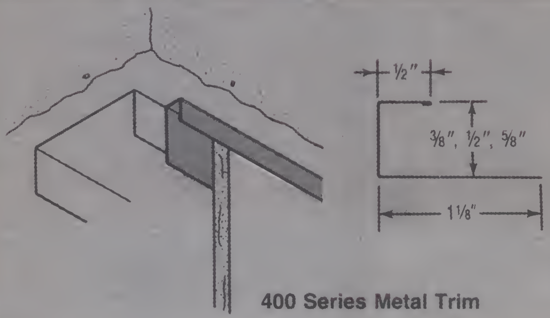
No. 200-B Metal Trim



No. 200-C Metal Trim

edge of flange inserts into kerf to make trim adjustable for use with 3⁄8″, 1⁄2″ and 5⁄8″ gypsum panels. All require finishing with U.S.G. joint compounds.

No. 400 series—Reveal type all-metal trim for drywall panels, requires no finishing compound, includes **No. 400** in 3⁄8″ size, **No. 401** in 1⁄2″ size, **No. 402** in 5⁄8″ size.



400 Series Metal Trim

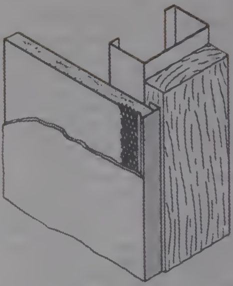
No. 700 series—All-metal trim provides neat edge protection for two-coat veneer finishes at cased openings and ceiling or wall intersections. Fine-mesh expanded flanges strengthen veneer bond and eliminate shadowing. **No. 701-A** channel-type, and **No. 701-B** angle edge trim provide 3⁄32″ grounds; sizes for 1⁄2″ and 5⁄8″ thick gypsum base.

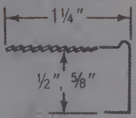
No. 800 series—All-metal trim companion to No. 700 series but with 1⁄16″ grounds for one-coat veneer finishes or finishing with joint compound in drywall applications. The 1 1⁄4″ wide fine-mesh flange provides a superior key and eliminates shadowing, is easily nailed or stapled. **No. 801-A** channel-type, and **No. 801-B** angle edge trim; sizes for 1⁄2″ and 5⁄8″ thick panels and bases.

vinyl trim

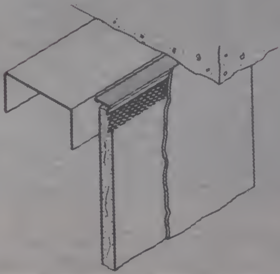
USG P-1 Vinyl Trim—A reveal-type white trim with flanges of rigid vinyl and integral flexible vinyl fins that compress on installation. Fins form permanent, flexible seal to effectively reduce sound transmission, replace caulking, provide structural-stress relief at panel perimeter. Fits tightly over edges of either 1⁄2″ or 5⁄8″ SHEETROCK Brand Panels or IMPERIAL Gypsum Base. Provides acoustical seal comparable in performance to one bead of acoustical sealant. Helps to stop condensation where board terminates at exterior metal surfaces such as window mullions. Requires no finishing compound; paints easily; includes **P-1A** in 1⁄2″ size, **P-1B** in 5⁄8″ size.

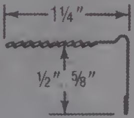
USG P-2 Vinyl Trim—A channel-shaped rigid vinyl trim with a pressure-sensitive adhesive backing for attachment to the wall at wall-ceiling intersections in both drywall and veneer finish systems. Provides positive perimeter relief in radiant heat ceilings and between gypsum board and concrete ceilings. Allow 1⁄8″ to 1⁄4″ clear space for insertion.



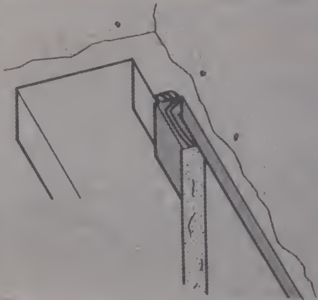


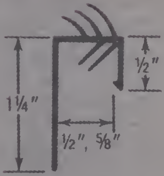
Nos. 701-A & 801-A Metal Trim



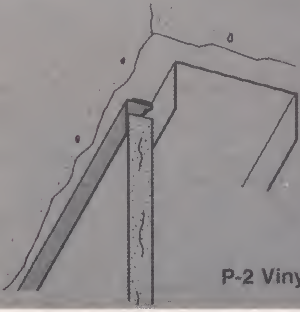


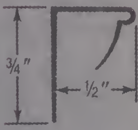
Nos. 701-B & 801-B Metal Trim



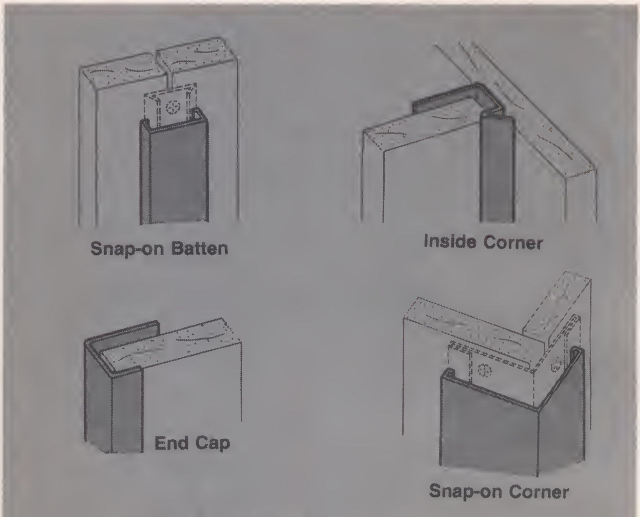


P-1 Vinyl Trim





P-2 Vinyl Trim



RP Series Vinyl Trim

USG Rigid Vinyl Trim (RP Series)—Precision-made of rigid vinyl plastic in four solid colors: ivory, tan, chocolate, black. Used to cover panel joints and edges, protect corners and trim edges of painted or predecorated panels. The ivory trim is especially recommended for use with painted panel surfaces. Available for ½″ and ⅝″ thick panels in four shapes. See TEXTONE Mouldings for shapes, sizes available.

GOSSEN Mouldings—Made of sturdy cellular vinyl, look like wood but have superior features as surface trim over drywall and veneer finishes. More economical than clear-grade softwoods. Resist impact, curling, cracking and splitting. Will not absorb moisture. Saw, miter and bend easily. Rapidly applied with nails or construction adhesive. Come in all full-size profiles (WP patterns), in both deep dimension and colonial designs. Available prestained or unfinished in solid white or natural embossed for quick on-site finishing with many paints, stains or varnishes. White vinyl, channel-type drywall trim for ⅜″, ½″, ⅝″ thick panels is also available in 8′ and 10′ lengths. See your local GOSSEN distributor for availability or contact Gossen, 2030 W. Bender Road, Milwaukee, Wisc. 53209.

control joints

USG Control Joints are used to relieve stresses induced by expansion and contraction across the control joint in large ceiling and wall expanses in drywall and veneer plaster systems. Used from door header to ceiling or from floor to ceiling in long partitions and wall furring runs; from wall to wall in large ceiling areas. Made from roll-formed zinc to resist corrosion; have a ¼″ open slot protected by plastic tape, removed after finishing.

Specifications—Trim Accessories

product	size		length ft[1]	approx. wt.	
	in	mm		1000 ft	kg/m
DUR-A-BEAD Corner Bead					
No. 101	1×1	25.4×25.4	6'8", 6'10", 8, 10	103	0.15
No. 103	1¼×1¼	31.8×31.8	8, 10	131	0.19
No. 104	1⅛×1⅛	28.6×28.6	6'8", 8	117	0.17
Expanded Flange Corner Bead					
No. 800	1¼×1¼	31.8×31.8	8, 10	83	0.12
No. 900	1¼×1¼	31.8×31.8		90	0.13
USG Metal Trim					
U-Shaped	½	12.7	7, 10	103	0.15
No. 200-A	⅝	15.9		110	0.16
L-Shaped	½	12.7	7, 10	80	0.12
No. 200-B	⅝	15.9		87	0.13
L-Shaped					
No. 200-C	⅞	22.2	7, 10	98	0.15
Reveal Type					
No. 400	⅜	9.5		118	0.18
No. 401	½	12.7	7, 8, 9, 10	125	0.19
No. 402	⅝	15.9		131	0.19
Channel Type	½	12.7	7	98	0.15
No. 701-A	⅝	15.9	10	106	0.16

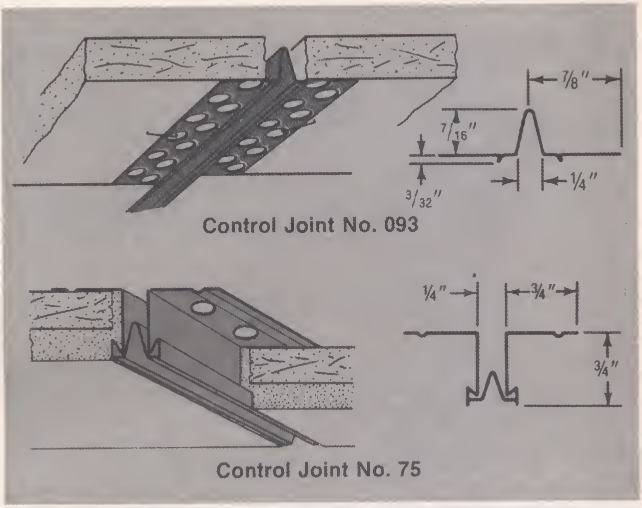
[1] Metric lengths: 6'8" = 2030 mm; 6'10" = 2080 mm; 7' = 2135 mm; 8' = 2440 mm; 9' = 2745 mm; 10' = 3050 mm.

(table continued on next page)

Specifications—Trim Accessories *continued*

product	size		length ft(1)	approx. wt.	
	in	mm		1000 ft	kg/m
USG Metal Trim, *continued*					
Angle Type	½	12.7	10	74	0.11
No. 701-B	⅝	15.9	10	80	0.12
Channel Type	½	12.7	8	95	0.14
No. 801-A	⅝	15.9	10	103	0.15
Angle Type	½	12.7	8	71	0.11
No. 801-B	⅝	15.9	10	77	0.11
USG Vinyl Trim					
P-1A	½	12.7	8, 10	100	0.15
P-1B	⅝	15.9	8, 10	105	0.16
P-2	½	12.7	10	45	0.07
USG Control Joint					
No. 093	3/32	2.4	10	115	0.17
No. 75	¾	19.1	10	210	0.28

(1) Metric lengths: 7′ = 2135 mm; 8′ = 2440 mm; 9′ = 2745 mm; 10′ = 3050 mm.



Control Joint No. 093

Control Joint No. 75

Limitation: where sound control is a prime consideration, a seal must be provided behind the control joint.

USG Control Joint No. 093—For interior applications; provides 3⁄32″ grounds for drywall and veneer finishes. Staple-applied to panel face; requires finishing.

USG Control Joint No. 75—Used in radiant heat ceiling systems to minimize surface cracking.

Structural Components

U.S.G. leads the industry in development of structural components for gypsum construction. They offer the advantages of light weight, low material cost and quick erection, superior strength and versatility in meeting job requirements. All are noncombustible, made from corrosion-resistant steel.

It is important that light-gauge steel components such as steel studs and runners, furring channels and resilient channels be adequately protected against rusting in the warehouse and on the job site. In marine areas such as the Caribbean, Florida and the Gulf Coast where salt-air conditions exist with high humidity, components which offer increased protection against corrosion should be used.

USG steel studs and runners

USG Studs and Runners are channel-type, roll-formed from corrosion-resistant steel, and designed for quick screw attachment of facing materials. They are strong, non-load bearing components of interior partitions, ceilings and column fireproofing and as framing for exterior curtain wall systems. Heavier thickness members are used in load-bearing construction. Limit-

ed chaseways for electrical and plumbing services are provided by punchouts in the stud web. Matching runners for each stud size align and secure studs to floors and ceilings, also function as headers. Made with 1″ and 1¼″ leg as noted. Studs and runners are end color-coded at the factory to indicate gauge and help identify products on the job. Available in various styles and widths outlined below:

ST Studs and CR Runners—Efficient, low-cost 25-ga. members for framing non-load bearing interior assemblies. Studs come in five widths—1⅝″, 2½″, 3⅝″, 4″, 6″—and 8 to 16-ft. lengths.

STL Studs and CRL Runners—Light-duty series studs in three widths—1⅝″, 2½″, 3⅝″—and 8- to 12-ft. lengths to match intended function. Runners come in five widths—1⅝″, 2½″, 3⅝″, 4″, 6″—10-ft. lengths.

CWS Studs and CWR Runners—Heavier 20-ga. members used in framing interior assemblies requiring greater-strength studs and as reinforcement for door frames. Also used in curtain wall assemblies—see separate Curtain Wall technical folder SA-805 for information. Studs available in 2½″, 3⅝″, 4″, 6″ widths—lengths up to 28 ft. Runners come in studs widths, (with 1″ or 1¼″ unhemmed leg), 10-ft. lengths.

Studs and Runners, styles ST, CR, STL, CRL, CWS and CWR, are made from steel having 33 ksi min. yield strength. Corrosion-resistant coatings are hot-dip galvanized per ASTM A525, aluminized per ASTM A463 or 55% aluminum-zinc. These items carry a two-part code that identifies the size (212—2½″, 358—3⅝″, etc.) and style—ST and CR (25 ga.), STL and CRL (26 ga.), CWS and CWR (20 ga.). For structural properties, see Appendix.

SJ, CS Studs and CR Runners—Used for framing load-bearing interior and exterior walls and non-load bearing curtain walls. **SJ style** with stiffened flanges available in five sizes and **CS style** in four sizes with unstiffened flanges and less load capacity for greater economy in selecting stud sizes. Products are designated by three-part code that identifies size (35—3½″, 362—3⅝, etc.); style (SJ—stud/joist, CS—channel stud. CR—C-Runner) and steel gauge thickness (see table below). Structural properties and specifications are shown in technical folder SA-510.

Thickness—Steel Studs and Runners(1)

style	design (2)		minimum		gauge (3)	end color code
	in	mm	in	mm		
STL, CRL	0.0168	0.43	0.0160	0.41	26	pink
ST, CR	0.0188	0.48	0.0179	0.45	25	none
SJ, CS, CR 22	0.0299	0.76	0.0284	0.72	22	blue
CWS, CWR	0.0344	0.87	0.0329	0.84	20	white
SJ, CS, CR 20	0.0359	0.91	0.0341	0.87	20	white
SJ, CS, CR 18	0.0478	1.21	0.0454	1.15	18	yellow
SJ, CS, CR 16	0.0598	1.52	0.0568	1.44	16	green
SJ, CS, CR 14	0.0747	1.90	0.0710	1.80	14	orange

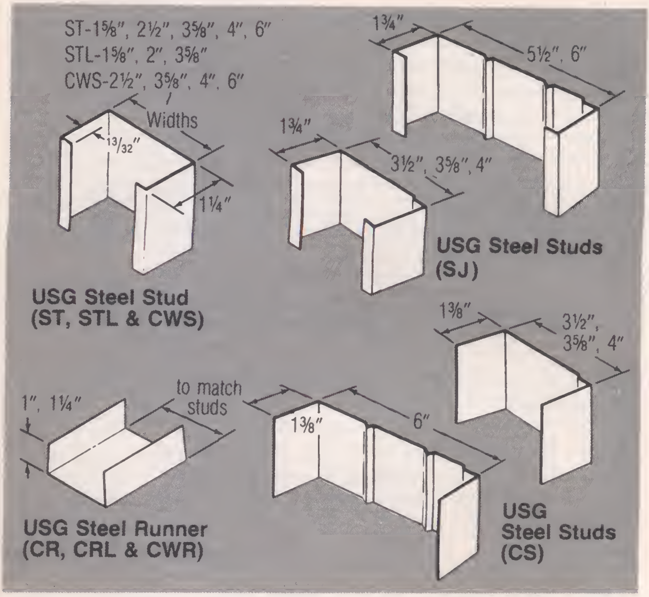
(1) Uncoated steel thickness; meets ASTM A568. Studs meet ASTM C645 except STL series. Min. yield strength 33 ksi, except SJ and CS studs 40 ksi. Coatings are hot-dip galvanized per ASTM A525; aluminized per ASTM A463, or 55% aluminum-zinc. (2) Conforms to AISI Specification for the Design of Cold Formed Steel Structural Members, 1980 edition. (3) For information only; refer to limiting height tables and structural properties for design data.

There is a serious misconception within the construction industry regarding the substitution of one manufacturer's studs for those of another manufacturer. The assumption is that all studs of a given size and steel thickness are interchangeable. That assumption is completely false. It's possible that the substitution can safely be made, but the decision should not be made until the *structural properties* of the studs involved are *compared*. Most reliable manufacturers publish structural property tables in their technical literature. U.S.G. includes this data in all architectural technical literature covering steel-framed systems, and in the Appendix of this manual.

Specifications—USG Steel Studs and Runners

product	width		length[1]	approx. wt.			
	in	mm	ft	lb/1000 ft		kg/100m	
ST Style Studs							
158ST	1⅝	41.3	8, 9	325		48.3	
212ST	2½	63.5	8, 9, 10, 12	375		55.8	
358ST	3⅝	92.1	8, 9, 10, 12	450		66.9	
400ST	4	101.6	8, 9, 10, 12	475		70.6	
600ST	6	152.4	up to 20	610		90.7	
CR Style Runners				1″ leg	1¼″ leg	1″ leg	1¼″ leg
158CR	1⅝	41.3		230	270	34.3	40.3
212CR	2½	63.5		290	320	43.3	47.7
358CR	3⅝	92.1	10	370	400	55.2	59.7
400CR	4	101.6		380	420	56.7	62.6
600CR	6	152.4		520	—	77.6	—
STL Style Studs							
158STL	1⅝	41.3	8	283		42.1	
212STL	2½	63.5	8, 9	332		49.4	
358STL	3⅝	92.1	8, 9, 10, 12	402		59.8	
CRL Style Runners				1″ leg	1¼″ leg	1″ leg	1¼″ leg
158CRL	1⅝	41.3		221	252	32.9	37.5
212CRL	2½	63.5		275	307	40.9	45.7
358CRL	3⅝	92.1	10	347	378	51.6	56.2
400CRL	4	101.6		370	402	55.1	59.8
600CRL	6	152.4		495	—	73.7	—
CWS Style Studs							
212CWS	2½	63.5		725		107.9	
358CWS	3⅝	92.1	up to 28	850		126.5	
400CWS	4	101.6		900		133.9	
600CWS	6	152.4		1170		174.1	
CWR Style Runners				1″ leg	1¼″ leg	1″ leg	1¼″ leg
212CWR	2½	63.5		570	630	94.0	93.7
358CWR	3⅝	92.1	10	715	775	106.6	115.3
400CWR	4	101.6		760	820	113.3	122.0
600CWR	6	152.4		1015	1075	151.4	160.0

[1]Metric lengths: 8 ft.=2440 mm; 9 ft.=2745 mm; 10 ft.=3050 mm; 12 ft.=3660 mm; 20 ft.=6100 mm; 28 ft.=8530 mm.



USG Cavity Shaft Wall & Area Separation Wall Components

These steel components are lightweight, versatile non-load bearing members of economical, fire and sound-barrier systems used in lieu of masonry for: (1) Area Separation Walls between units in multifamily wood-frame buildings; (2) Shaft Walls around elevator and mechanical shafts, return air ducts, stair-wells and smoke shafts in multi-story buildings. Components are formed from corrosion-resistant steel: C-H Studs from Lock Forming Quality steel meeting ASTM A527 with 40 ksi min. yield strength. Corrosion-resistant coatings supplied are: G60 hot-dip galvanized meeting ASTM A525, aluminized meeting ASTM A463, or 55% aluminum-zinc. Items are end color-coded at the

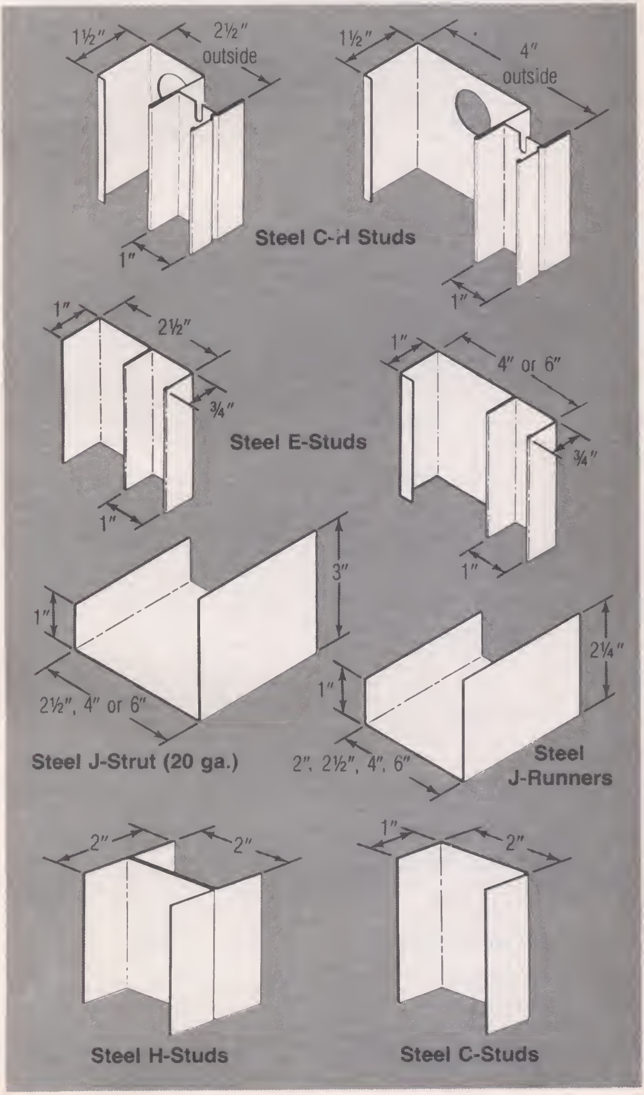
Thickness—Separation and Shaft Wall Components

style	design(2) in	design(2) mm	minimum in	minimum mm	gauge(3)
CH, ES 25	0.0209	0.53	0.0199	0.51	25
JR 24	0.0239	0.61	0.0227	0.58	24
CH 22	0.0310	0.79	0.0294	0.75	22
ES, JR, JS, CH 20	0.0359	0.91	0.0341	0.87	20

(1) Uncoated steel thickness; meets ASTM A568. Studs meet ASTM C645. Base metal meets ASTM A446 standards for structural performance. Min. yield strength 33 ksi, except C-H stud 40 ksi. Coatings are hot-dip galvanized per ASTM A525; aluminized per ASTM A463, or 55% aluminum-zinc. (2) Conforms to AISI Specification for the Design of Cold Formed Steel Structural Members, 1980 edition. (3) For information only; refer to limiting height tables and structural properties for design data.

factory to indicate thickness as follows: 25 ga. black, 24 ga. red, 22 ga. blue, 20 ga. white.

Cavity Wall Components—2½″ and 4″ wide and designed for use with 1″ thick USG Gypsum Liner Panels. **USG Steel C-H Studs** are non-load bearing sections installed between abutting liner panels. They have 1″ holes spaced 16″ from each end for easy installation of horizontal pipe and conduit. **USG Steel E-Studs** are 2½″, 4″ or 6″ wide, used singly to cap panels at intersections with exterior walls or back-to-back as studs in



unusually high partitions. **USG Steel J-Runners** are used singly at top and bottom of wall and back-to-back between vertical liner panels at intermediate floors, in Area Separation Walls. **USG Steel J-Struts,** 2½″, 4″ and 6″ wide, are used in jamb framing for fire-rated elevator doors.

Solid Wall Components—2″ wide and used with two thicknesses of 1″ Gypsum Liner Panels. **USG Steel H-Studs** fit over and engage edges of adjacent liner panels. **USG Steel C-Studs** are used singly to cap partitions. **USG Steel J-Runners** are used as floor and top runners and back-to-back between liner panels at intermediate floors.

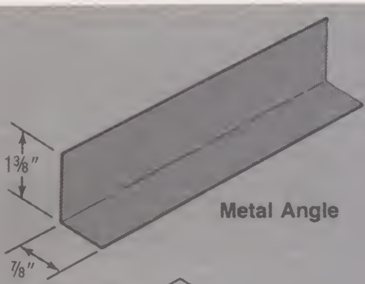
Specifications—Area Separation Wall & Shaft Wall Components

product	size		length		approx. wt.	
	in	mm	ft	mm	lb/1000 ft	kg/100m
C-H Studs						
212CH25	2½	63.5	8 to 16	2440 to 4880	595	88.5
212CH22	2½	63.5	8 to 18	2440 to 5490	850	126.5
400CH25	4	101.6	8 to 16	2440 to 4880	705	104.9
400CH20	4	101.6	8 to 25	2440 to 7620	1245	185.3
E-Studs						
212ES25	2½	63.5	8 to 28	2440 to 8530	460	68.4
212ES20	2½	63.5	8 to 28	2440 to 8530	700	104.2
400ES25	4	101.6	8 to 28	2440 to 8530	610	90.8
400ES20	4	101.6	8 to 28	2440 to 8530	930	138.4
600ES25	6	152.4	8 to 28	2440 to 8530	1545	229.9
600ES20	6	152.4	8 to 28	2440 to 8530	2375	353.4
J-Runners						
200JR24	2	50.8	10	3050	460	68.4
200JR20	2	50.8	10	3050	673	100.2
212JR24	2½	63.5	10	3050	535	79.6
212JR20	2½	63.5	10	3050	736	109.5
400JR24	4	101.6	10	3050	680	101.2
400JR20	4	101.6	10	3050	937	139.4
600JR24	6	152.4	10	3050	860	128.0
600JR20	6	152.4	10	3050	1191	177.2
H-Studs						
200HS24	2	50.8	8 to 16	2440 to 4880	685	101.9
200HS20	2	50.8	8 to 16	2440 to 4880	1010	150.3
C-Studs						
200CS24	2	50.8	8 to 16	2440 to 4880	345	51.3
200CS20	2	50.8	8 to 16	2440 to 4880	505	75.1
J-Strut						
212JS20	2½	63.5	8 to 12	2440 to 4880	826	122.9
400JS20	4	101.6	8 to 12	2440 to 4880	1026	152.7
600JS20	6	152.4	8 to 12	2440 to 4880	1287	191.5

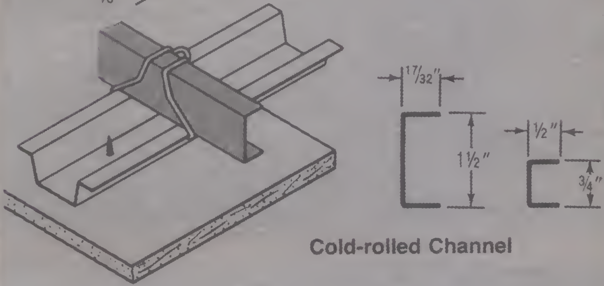
structural accessories

USG Metal Angles—1⅜″×⅞″×24-ga. galvanized steel angle sections used to secure and brace 1″ coreboard in vent shaft partitions and in framing caged beam construction. Length 10 ft.; approx. wt. 190 lb./1,000 ft. Other angles available on special order.

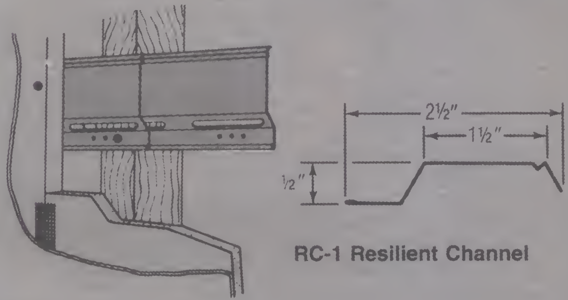
USG Cold-Rolled Channels—Made of 16-ga. steel, are used in furred walls and suspended ceilings. Available either galvanized or black asphaltum painted. Sizes ¾″ with ½″ flange, 1½″ with 17/32″ flange; lengths 16 and 20 ft.; approx. wt. ¾″—300 lb./1,000 ft., 1½″—500 lb./1,000 ft.



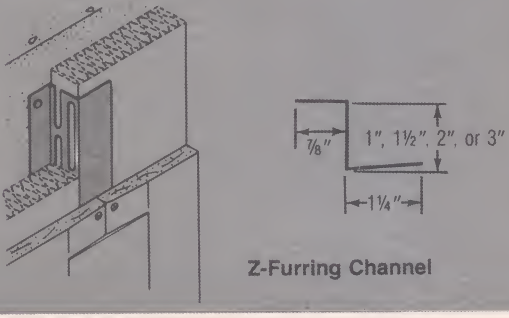
Metal Angle



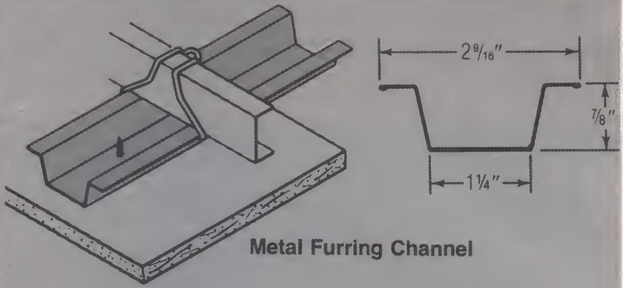
Cold-rolled Channel



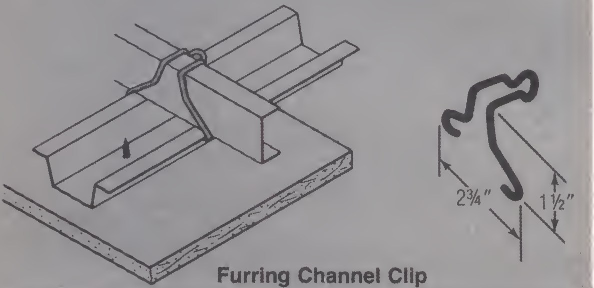
RC-1 Resilient Channel



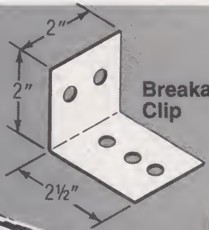
Z-Furring Channel



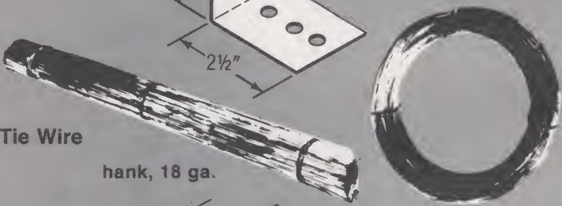
Metal Furring Channel



Furring Channel Clip



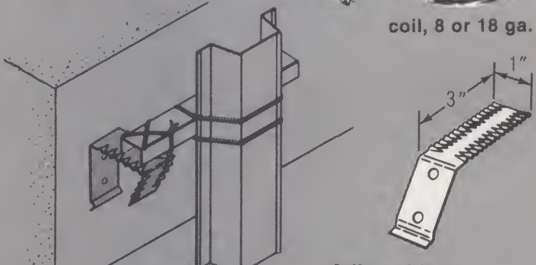
Breakaway Clip



Tie Wire

hank, 18 ga.

coil, 8 or 18 ga.



Adjustable Wall Furring Bracket

RC-1™ Resilient Channel—Made of min. 25-ga. galvanized steel, is one of the most effective, lowest-cost methods of improving sound transmission loss through wood-frame partitions and ceilings. Used for resilient attachment of SHEETROCK Brand Panels, IMPERIAL and USG R.H. Gypsum Bases. Pre-punched holes 4″ o.c. in the flange facilitate screw attachment to framing; facing materials are screw-attached to channels. Size ½″×2½″; length 12 ft.; approx. wt. 200 lb./1,000 ft.

Limitation: not for use beneath highly flexible floor joists; should be attached to ceilings with 1¼″ USG Type W or S Screws only—nails must not be used; see Framing Requirements, Chapter 2.

USG Z-Furring Channels—Made of min. 24-ga. hot-dipped galvanized steel used to mechanically attach THERMAFIBER Z-Furring Blankets, FOAMULAR Polystyrene Insulation (or other rigid insulation) and gypsum panels or base to interior side of monolithic concrete and masonry walls. Sizes 1″, 1½″, 2″, 3″; length 8′6″, approx. wt. (lb/1000 ft): 224 (1″), 269 (1½″), 313 (2″), 400 (3″).

USG Metal Furring Channels—Roll-formed, hat-shaped sections made of min. 25-ga. galvanized steel. They are designed for screw attachment of gypsum panels and base in wall and ceiling furring. Size ⅞″×2⁹⁄₁₆″; length 12 ft.; approx. wt. 276 lb./1,000 ft.

USG Furring Channel Clips—Made of galvanized wire and used in attaching USG Metal Furring Channels to 1½″ cold-rolled channel ceiling grillwork. For use with single-layer gypsum panels or base. Clips are installed on alternate sides of 1½″ channels; where clips cannot be alternated, wire-tying is recommended. Size 1½″×2¾″; approx. wt. 38 lb./1,000 pcs.

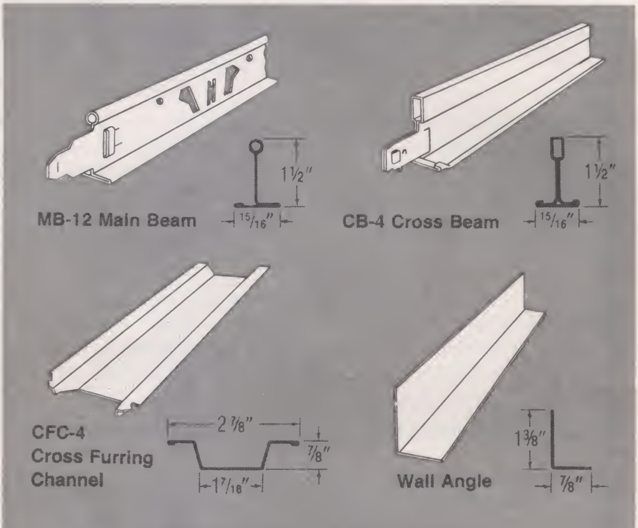
USG Adjustable Wall Furring Brackets—Used for attaching ¾″ cold-rolled channels and USG Metal Furring Channels to interior side of exterior masonry walls. Made of 20-ga. galvanized steel with corrugated edges, brackets are attached to masonry and wire-tied to horizontal channel stiffeners in braced furring systems. Permits adjustment from ¼″ to 2¼″ plus depth of channel. Approx. wt. 56 lb./1,000 pcs.

USG Tie Wire—Galvanized soft annealed wire available in two sizes: **8-ga. wire,** used for hangers in suspended ceiling grillwork, available in 50-lb. coils (approx. 730 ft.); **18-ga. wire,** used for wire-tying channels in wall furring and ceiling construction, available in 50-lb. coils (approx. 8,310 ft.) and 25-lb. hanks (48″ straight lengths—4,148 ft. total).

USG Breakaway Clip—A 2″ wide, angle clip made of .063″ thick aluminum. Used to attach Area Separation Walls to intermediate floor and roof framing. Clips are designed to melt and break away when exposed to fire. Size 2½″×2″; approx. wt. 60 lb./1,000 pcs.

USG Direct Suspension System is a direct-hung steel ceiling grid for screw application of gypsum panels in commercial and industrial buildings. This modular system consists of simple, fast-erecting, snap-lock parts. **Main Beam MB-12** standard

heavy-duty tee beam prepunched for intersecting components; splices without clips or plates. Length: 12 ft. **Cross Furring Channel CFC-4** simply locks into main beam. Knurled surface and 25-ga. steel speed screw penetration. Length: 4 ft. **Cross Beam CB-4** supports edge of standard 2x4 ft. lighting fixtures. Length: 4 ft. **Wall Angle** supports Cross Furring Channels, provides backup for gypsum panels at wall. Length: 10 ft.



USG Direct Suspension System

Sound Control and Insulation Products

Adequate sound control and energy conservation are among the most important requirements in today's buildings. The public has become sufficiently aware of these factors to demand effective measures to control unwanted sound and heat transfer in both commercial and residential construction. With its advanced research, U.S.G. has been a leader in developing new systems and products for efficient, low-cost sound control and thermal insulation for new construction and remodeling.

THERMAFIBER Insulation products meet every important insulation need—thermal, acoustical and fire protection. They provide superior resistance to heat and sound transmission, resilience that assures full installed thickness and outstanding durability.

THERMAFIBER Insulation products consist of spun mineral fibers formed into mats of varying dimensions and densities, or into nodules for pouring or blowing into framing spaces.

The use of THERMAFIBER Insulation products increases fire ratings of certain partition assemblies—provide greater fire resistance than low-melt point, glass-fiber insulation. Products

without facings are rated noncombustible as defined by NFPA and National Fire Code when tested per ASTM E136.

THERMAFIBER Insulation Blankets offer excellent sound-absorbing properties, in addition to providing thermal values. When used in partition cavities, THERMAFIBER Insulation improved STC ratings up to nine points. All THERMAFIBER Insulation products are asbestos-free. They resist decay, corrosion, moisture and will not support vermin.

THERMAFIBER Regular Blankets and Aluminum Foil-Faced Blankets, faced with foil or kraft vapor retarders which contain asphalt, should be treated as a flammable surface, never exposed to open flame or used where they will remain exposed.

products available:

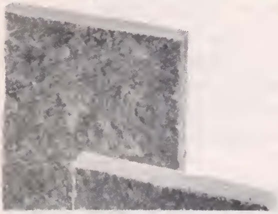
THERMAFIBER Sound Attenuation Blankets—Paperless, semi-rigid spun mineral fiber mat which substantially improves STC ratings when used in stud cavities of U.S.G. partition assemblies. Each blanket has a dense, highly complex labyrinthine structure composed of fibers which produce millions of sound-retarding air pockets. Easily handled and cut; simple to install. Meet Federal Specification HH-I-521F, Type I except identification marking paragraph 3.7.1.

THERMAFIBER W-S Insulating Blankets—Eliminate need for staple fastening because they are paperless. Made slightly wider than normal to give snug friction fit between wood studs. W-S Insulating Blankets require a separate vapor retarder, such as Foil-back SHEETROCK Brand Gypsum Panels or Foil-back ROCKLATH or IMPERIAL Gypsum Base, or a 6-mil polyethylene film. Specially designed for use with FOAMULAR Polystyrene Insulation. With this product, 3½″ THERMAFIBER W-S Blankets are used in load-bearing, wood-framed exterior walls having a 1-hr. fire rating. Use for sidewalls only. Meet ASTM C665 and Federal Specification HH-I-521F, Type I except identification marking paragraph 3.7.1.

THERMAFIBER M-S Insulating Blankets—Specially designed for insulating exterior furring and curtain wall assemblies which utilize steel studs. They are flangeless, open-faced and require same types of separate vapor retarder as W-S Blankets. With FOAMULAR Polystyrene Insulation, 3⅝″ M-S Insulating Blankets are used in load-bearing, steel-frame exterior walls offering a 1-hr. fire rating. Meet ASTM C665 and Federal Specification

THERMAFIBER
Sound Attenuation Blanket

THERMAFIBER
M-S and W-S Blankets



THERMAFIBER
Z-Furring Blanket

THERMAFIBER
Flame-Resistant Blanket

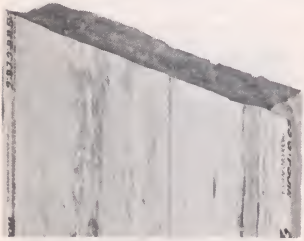
HH-I-521F, Type I except identification marking paragraph 3.7.1.

THERMAFIBER Z-Furring Blankets—Designed for use as an effective semi-rigid insulating material in applications using USG Z-Furring Channels. They are a paperless, semi-rigid spun mineral fiber mat and require a separate vapor retarder, like W-S Blankets. Meet Federal Specification HH-I-521F, Type I except identification marking paragraph 3.7.1.

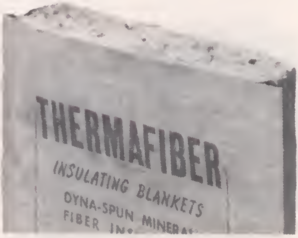
THERMAFIBER Flame-Resistant Blankets—Open-faced, foil-covered on vapor retarder side. The foil-kraft laminate is applied with a special flame-resistant adhesive. Blankets require a minimum air space same as Foil-Faced Blankets for improved installed thermal resistance. Used for ceilings, floors, walls for flame-resistant insulation and vapor control or where insulation will be exposed. See Appendix for UL surface burning characteristics. Meet Federal Specification HH-I-521F, Type III and ASTM C665.

THERMAFIBER Regular Blankets—Faced on one side with sturdy asphalted vapor retarder that extends to form a strong nailing flange. Encased on the other side with porous kraft paper. These blankets also are supplied open-faced without breather paper. Used in ceilings, floors, walls. Meet Federal Specification HH-I-521F, Type II and ASTM C665.

THERMAFIBER Aluminum Foil-Faced Blankets—Similar to paper-enclosed Regular Blankets, but with highly reflective aluminum foil laminated to vapor retarder side to protect against condensation. A minimum adjoining air space of ½″ in sidewalls



THERMAFIBER
Aluminum Foil-Faced Blanket



THERMAFIBER
Regular Blanket

Specifications—THERMAFIBER Blankets(1)

product	thickness in	thickness mm	width in	width mm	length ft	length m	density lb/ft³	density kg/m³	thermal resistance(2) (R)(3) F·h·ft²(4)/Btu	thermal resistance (R) K·m²(4)/W
Sound Attenuation	1 1½ 2 3	25 38 51 76	16 and 24	406 and 610	4	1.22	4.0 3.0 2.5 4.0	0.25 0.19 0.16 0.25	4 6 7 12	0.7 1.1 1.2 2.1
W-S	3½	89	15 and 23	381 and 584	4	1.22	3.0	0.19	13	2.3
M-S	3 3⅝	76 92	16 and 24	406 and 610	4	1.22	3.0	0.12	11 13	1.9 2.3
Z-Furring	1 1½ 2 3	25 38 51 76	16 and 24	406 and 610	4	1.22	6.0 4.5 4.0 4.0	0.37 0.28 0.25 0.25	4 6 8 12	0.7 1.1 1.4 2.1
Regular	3 3½ 5¼ 6	76 89 133 152	16 and 24	406 and 610	4	1.22	2.0	0.12	11 13 19 22	1.9 2.3 3.3 3.9
Aluminum Foil-Faced	3 3½ 5¼ 6	76 89 133 152	15 and 23	381 and 584	4 and 8	1.22 and 2.44	2.0	0.12	11 13 19 22	1.9 2.3 3.3 3.9
Flame-Resistant	3 3½ 5¼ 6	76 89 133 152	16 and 24	406 and 610	4	1.22	3.0	0.12	11 13 19 22	1.9 2.3 3.3 3.9

(1) Check local availability of package sizes. (2) C factor = $\frac{1}{R}$; K factor = $\frac{1}{R/\text{thickness}}$.
(3) "R" value at 75°F (24°C), without facing.
(4) Symbols: °F = degrees Fahrenheit; h = hour; Btu = British thermal units; K = degrees Kelvin; W = watts.

Sound Attenuation Blankets fit snugly between steel studs (right). Proper stapling of Regular Blankets is to sides of wood studs (below).

and 1″ in ceilings is required to obtain insulating value from the foil reflectivity. Used in ceilings, walls, floors with air space—most effective with air-conditioning and in areas of extreme summer temperatures. Meet Federal Specification HH-I-521F, Type III and ASTM C665.

For data on THERMAFIBER Safing, Curtain Wall and Mineral Fireproofing, see technical folder SA-707.

extruded polystyrene insulation

FOAMULAR® Polystyrene Insulation, a product of UC Industries, provides exceptionally low thermal conductivity and high water resistance properties. These excellent properties are incorporated in buildings systems developed by United States Gypsum for energy savings in new buildings and old.

Performance-tested assemblies combine FOAMULAR Insulation with conventional materials in 1-hour fire-rated, load-bearing walls with steel- or wood-stud framing. FOAMULAR Panels economically insulate masonry cavity walls, foundations and slab perimeters; and, with USG Z-Furring Channels, exterior masonry and concrete walls.

FOAMULAR Polystyrene Insulation is extruded plastic foam. Closed-cell structure and continuous skin surfaces combine to provide high strength, rigidity and water-resistance for reliable, long-lasting performance—even below grade.

FOAMULAR Insulation complies with Federal Specification HH-I-

Typical Physical Properties—1-in. Thickness(1)

property	ASTM test reference	value
density—lb./ft.^{3}	C303	1.8
compressive strength—lb./in.^{2}	D1621	20.0(2)
flexural strength—lb./in.^{2}	C203	75.0(3)
dimensional stability—% linear change	D2126	2.0
thermal conductivity—"k" —Btu x in./ft.^{2}xhr.x°F. 40 °F mean temperature 75 °F mean temperature	C518	0.18 0.20
thermal resistance—"R" at 40 °F at 75 °F —hr./°F/Btu		5.4 5.0
water absorption—% by vol.	C272	0.1
water vapor transmission—perm-inch	C355	0.7
flame spread	E84	5(4)
smoke developed	E84	35(4)
capillarity	—	none

(1) Properties shown are representative values; for property ranges or specification limits, consult your sales representatives. (2) Value at 10% deformation. (3) Average of values from tests conducted in longitudinal and transverse directions (FOAMULAR Extruded Polystyrene Insulation is anisotropic). (4) This rating is not intended to reflect the hazard presented by this material under actual fire conditions.

524C, Type IV; and is accepted by code authorities under Research Reports: BOCAI 82-36, ICBO 3628, SBCCI 8189. It is classified as Foamed Plastic by Underwriters Laboratories Inc. (see Classification Certificate U-197).

NOTE: This product will ignite if exposed to fire of sufficient heat and intensity.

Specifications—FOAMULAR Insulation[(1)]

	thickness					
width x length	**¾″**	**1**	**1½″**	**2″**	**2½″**	**3″**
square edge (SE)						
16″ x 8′		X	X	X		X
24″ x 8′	X	X	X	X	X	X
48″ x 8′	X	X	X			
tongue & groove edge (T/G)						
24″ x 8′ or 9′ [(2)]	X	X	X	X		
48″ x 8′ or 9′ [(3)]	X	X	X			

(1) Weight: approx. 150 lb/1000 ft², per inch thickness.
(2) T/G on four edges. (3) T/G long edges. Other sizes available on request.

Fasteners

USG Screws—The result of many years of development aimed at producing the best results in both drywall and veneer construction. Their development has made possible today's broad selection of systems with gypsum boards applied over steel framing. A complete line of special self-drilling, self-tapping steel screws is available including types with a double-lead thread design which produces up to 30% faster penetration, less screw stripping, and greater holding power than conventional fasteners.

Screws are corrosion-resistant and all (except Hex Washer Head type) have a Phillips-head recess for rapid installation with a special bit and power-driven screwdriver. The bugle head spins the face paper into the cavity under the screwhead for

greater holding power and helps prevent damage to the gypsum core and face paper. Defects associated with improper nail dimpling are eliminated. Other head types are designed specifically for attaching metal to metal and installing wood and metal trim. Screws meet ASTM 646.

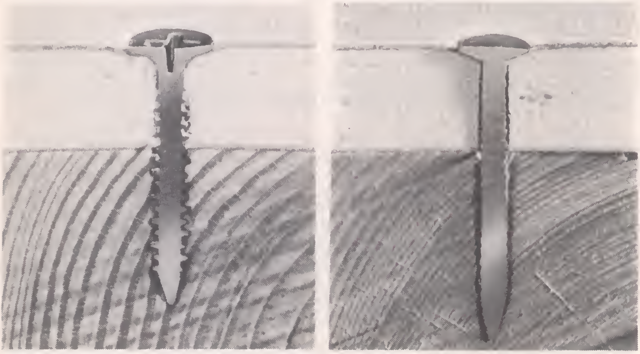
Type S Screws have specially designed drill point and threads that minimize stripping, provide maximum holding power in USG Steel Studs and Runners. Type S Screws are designed for use with steel up to .04″ thick; Type S-12 Screws for steel from .04″ to .07″ thick (see table, below). The special threads on Type G and Type W Screws offer superior holding power in attachment to gypsum boards and wood framing, respectively. TAPCON® Anchors provide fast, safe attachment of steel components to poured concrete and concrete block surfaces. Special $1\frac{15}{16}$″ Type S-12 Bugle Head Pilot Point Screws are designed for attachment of plywood to steel joists and studs.

Steel Thickness/Screw Type

steel thickn. /In. (†)	gauge	screw type	steel thickn. /In. (†)	gauge	screw type
.02	25	S	.05	18	S-12
.03	22	S	.06	16	S-12
.04	20	S or S-12	.07	14	S-12
			.10	12	S-4

†Nom. uncoated steel.

The superior holding power of Type W Screws has virtually eliminated loose panel attachment and nail "pops" in wood frame construction (see U.S.G. brochure CS-20 for details). Tests have shown the Type W Screw to have 350% greater pullout strength than GWB-54 nails. Fewer screws than nails are



Secret to superiority of USG Screw attachment is shown by comparative diagrams. Bugle-head screw (left) depresses face paper of gypsum panel without tearing; threads cut into and deform wood to hold tightly. Longer drywall nail (right) grips with friction, loosens hold as wood shrinks, which may pop nailhead above surface to create callback problem.

generally required, and the speed of installation using electric screwguns compares favorably with nailing.

SUPER-TITE Screws—High quality, economical screws for interior framing applications. These self-drilling, self-tapping steel screws have specially designed drill point and threads to assure fast penetration into steel and wood framing. Sizes available: 1″, 1⅛″, 1¼″, 1⅝″, 2¼″, 3″ Bugle Head for attaching gypsum panels to 20 and 25-ga. steel framing; 1¼″ W Bugle Head for attaching panels to wood framing; 7/16″ Pan Head for securing studs to runners. Comply with ASTM C646.

Selector Guide for USG Screws

fastening application	fastener used	fig[2]
GYPSUM PANELS TO STEEL FRAMING[1]		
½″ single-layer panels to steel studs, runners, channels	1″ Type S Bugle Head	1
⅝″ single-layer panels to steel studs, runners, channels	1″ Type S Bugle Head 1⅛″ Type S Bugle Head	1 1
1″ coreboard to metal angle runners in solid partitions	1¼″ Type S Bugle Head	1
½″ double-layer panels to steel studs, runners, channels	1⅝″ Type S Bugle Head	2
⅝″ double-layer panels to steel studs, runners, channels	1⅝″ Type S Bugle Head	2
½″ panels through coreboard to metal angle runners in solid partitions	1⅞″ Type S Bugle Head	2
⅝″ panels through coreboard to metal angle runners in solid partitions	2¼″ Type S Bugle Head 3″ Type S Bugle Head	2 2
1″ double-layer coreboard to steel studs, runners	2⅝″ Type S Bugle Head	2
WOOD TO STEEL FRAMING		
Wood trim over single-layer panels to steel studs, runners	1″ Type S or S-12 Trim Head 1⅝″ Type S or S-12 Trim Head	5 5
Wood trim over double-layer panels to steel studs, runners	2¼″ Type S or S-12 Trim Head	5
Steel cabinets, brackets through single-layer panels to steel studs	1¼″ Type S Oval Head	6
Wood cabinets through single-layer panels to steel studs	1⅝″ Type S Oval Head	6
Wood cabinets through double-layer panels to steel studs	2¼″, 2⅞″, 3¾″, Type S Oval Head	6
STEEL STUDS TO DOOR FRAMES, RUNNERS		
Steel studs to runners (ST)	⅜″ Type S Pan Head	9
Steel studs to runners (CWS)	⅜″ Type S-12 Pan Head ⅝″ Type S-12 Low-Profile Head	10 11
Steel studs to door frame jamb anchor clips		
Other metal-to-metal attachment (12-ga. max.)		

(table continued on next page)

Selector Guide for USG Screws *continued*

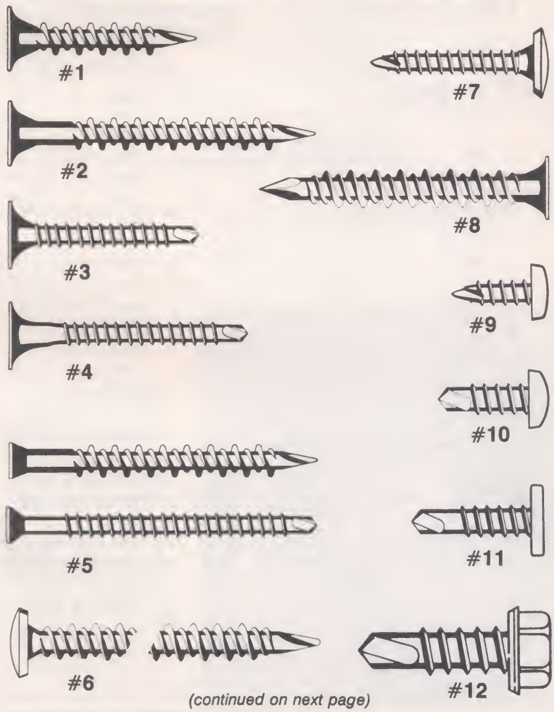
fastening application	fastener used	fig(2)
STEEL STUDS TO DOOR FRAMES, RUNNERS *continued*		
Steel studs to door frame jamb anchor clips (heavier shank assures entry in clips of hard steel)	½″ Type S-12 Pan Head ⅝″ Type S-12 Low-Profile Head	10 11
Strut studs to door frame clips, rails, other attachments in ULTRAWALL movable partitions	½″ Type S-16 Pan Head Cadmium-Plated	10
Metal-to-metal connections up to double thickness of 12-ga. steel	¾″ S-4 Hex Washer Head Cadmium-Plated	12
GYPSUM PANELS TO 12-GA. (MAX.) STEEL FRAMING		
½″ and ⅝″ panels and gypsum sheathing to steel studs and runners; specify cadmium-plated screws for exterior curtain wall applications	1″ Type S-12 Bugle Head	3
USG Self-Furring Metal Lath and brick wall ties through gypsum sheathing to steel studs and runners; specify cadmium-plated screws for exterior curtain wall applications	1¼″ Type S-12 Bugle Head 1¼″ Type S-12 Pancake Head	4 13
½″ and ⅝″ double-layer gypsum panels to steel studs and runners	1⅝″ Type S-12 Bugle Head	4
Multilayer gypsum panels and other materials to steel studs and runners	1⅞″, 2″, 2⅜″, 2⅝″, 3″ Type S-12 Bugle Head	4
RIGID FOAM INSULATION TO STEEL FRAMING		
Rigid foam insulation panels to steel studs and runners; Type R for 20- 25-ga. steel	1½″, 2″, 2½″, 3″ Type S-12 or R Wafer Head	15
ALUMINUM TRIM TO STEEL FRAMING		
Trim and door hinges to steel studs and runners (screw matches hardware and trim)	⅞″ Type S-18 Oval Head Cadmium-Plated	7
Batten strips to steel studs in Demountable partitions	1⅛″ Type S Bugle Head	1
Aluminum trim to steel framing in Demountable and ULTRAWALL partitions	1¼″ Type S Bugle Head Cadmium-Plated	1
GYPSUM PANELS TO WOOD FRAMING		
⅜″, ½″ and ⅝″ single-layer panels to wood studs, joists	1¼″ Type W Bugle Head	1
RC-1 RESILIENT CHANNELS TO WOOD FRAMING		
Screw attachment required for ceilings, recommended for partitions	1¼″ Type W Bugle Head 1″ or 1¼″ Type S Bugle Head	1 1
For fire-rated construction	1¼″ Type S Bugle Head	1

Selector Guide for USG Screws *continued*

fastening application	fastener used	fig[2]
GYPSUM PANELS TO GYPSUM PANELS		
Multilayer adhesively laminated gypsum-to-gypsum partitions (not recommended for double-layer ⅜″ panels)	1½″ Type G Bugle Head	8
PLYWOOD TO STEEL JOISTS		
⅜″ to ¾″ plywood to steel joists (penetrates double thickness 14-ga.)	1¹⁵⁄₁₆″ Type S-12 Bugle Head, Pilot Point	16
STEEL TO POURED CONCRETE OR BLOCK		
Attachment of steel framing components to poured concrete and concrete block surfaces	³⁄₁₆″ × 1¾″ Acorn Slotted HWH TAPCON Anchor	14

Notes: [1]Includes USG Steel Studs and Runners, ST and CWS; Metal Angles; Metal Furring Channels; RC-1 Resilient Channels. If channel resiliency makes screw penetration difficult, use screws ⅛″ longer than shown to attach panels to RC-1 channels. For other gauges of studs and runners, always use Type S-12 screws. For steel applications not shown, select a screw length which is at least ⅜″ longer than total thickness of materials to be fastened. USG Screws are manufactured under U.S. Patent Nos. 3,207,023; 3,221,588; 3,204,442; 3,260,100.
[2]Figures refer to following screw illustrations.

Basic Types of Screws



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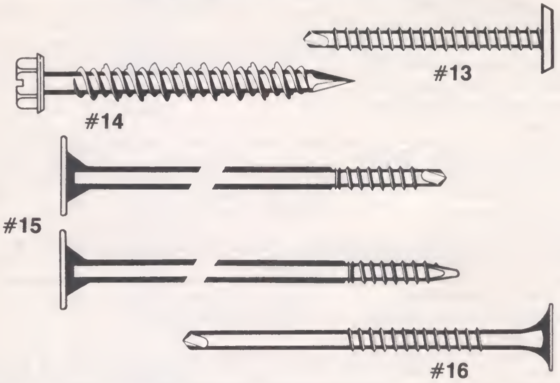
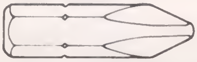
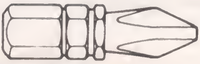
Basic Types of Screws *continued*



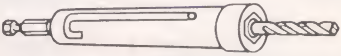
USG Bit Tips



No. 1 Bit for
trim and pancake heads



No. 2 Bit for
bugle, pan, wafer,
low-profile & oval heads



CONDRIVE Tool/Bit
for HWH TAPCON Anchors

Note: Hex-head bit not illustrated

Labor-saving is added advantage of screw attachment of gypsum panels and veneer base. Minimum screw spacing is 12″ and 16″ for ceilings and walls, respectively, compared to 7″ and 8″ spacing required for nails.

Specifications—USG Screws

description				bulk packaging			indiv. package w/o bits*		
length					approx. wt.			approx. wt.	
in	mm	type	head	qty.—1,000 pc	lb	kg	qty.—1,000 pc	lb/ctn	kg/ctn
BASE SCREWS									
1	25.4	S	bugle	10**	36	16.3	2	6(1)	2.7
1⅛	28.6	S	bugle	8**	32	14.5	2	7(1)	3.2
1¼	31.8	S	bugle	8**	34	15.4	2	8(1)	3.6
1⅝	41.3	S	bugle	5**	28	12.7	1	6(1)	2.7
1⅞	47.6	S	bugle	4	24	10.9	2	12(2)	5.4
2¼	57.2	S	bugle	2.5	19	8.6	1	8(2)	3.6
2⅝	66.7	S	bugle	2.5	24	10.9	1	10(2)	4.5
3	76.2	S	bugle	2	23	10.4	1	13(2)	5.8
SPECIALTY SCREWS									
⅜	9.5	S	pan	16**	47	21.3	5	11(2)	5.0
⅜	9.5	S-12	pan	16**	47	21.3	5	11(2)	5.0
½	12.7	S-12	pan	14**	48	21.8	3	10(2)	4.5
½	12.7	S-12	pancake	12	49	22.2	3	12(2)	5.4
½	12.7	S-16	pan (Cd)	14	48	21.8	3	10(2)	4.5
⅝	15.9	S-12	low-profile	10	36	16.3	2	8(2)	3.6
¾	19.1	S-4	hex washer (Cd)	3	40	18.1	—	—	—
⅞	22.2	S-18	oval (Cd)	10	50	22.6	2	8(1)	3.6
1	25.4	S	trim	—	—	—	2	6(1)	2.7
1	25.4	S-12	trim	—	—	—	2	6(1)	2.7
1	25.4	S-12	bugle	10**	35	15.8	2	6.5(1)	2.9
1¼	31.8	S-12	bugle	8**	35	15.8	2	7.5(1)	3.4
1¼	31.8	S	bugle (Cd)	8	34	15.4	1	4(1)	1.8
1¼	31.8	W	bugle	8**	33	14.9	2	8.3(1)	3.8
1¼	31.8	S-12	pancake	5	34	15.4	2	8(1)	3.6
1¼	31.8	S	oval	—	—	—	2	8(2)	3.6
1½	38.1	G	bugle	5	33	14.9	2	11(2)	5.0
1½	38.1	R	wafer	4	30	13.6	1	8(2)	3.6
1½	38.1	S-12	wafer	4	30	13.6	1	8(2)	3.6
1⅝	41.3	S	oval	—	—	—	1	8(1)	3.6
1⅝	41.3	S	trim	6	29	13.1	1	9(2)	4.1
1⅝	41.3	S-12	bugle	5	27	12.2	1	5.5(1)	2.5
1⅝	41.3	S-12	trim	6	29	13.1	2	9(2)	4.1
1⅞	47.6	S-12	bugle	4	25	11.3	2	12(2)	5.4
1 15/16	49.2	S-12	bugle, pilot pt.	3	36	16.3	1	12(2)	5.4
2	50.8	S-12	bugle	4	26	11.7	2	12(2)	5.4
2	50.8	R	wafer	3	32	14.5	1	16(3)	7.3
2	50.8	S-12	wafer	3	32	14.5	1	16(3)	7.3
2¼	57.2	S	trim	4	27	12.2	2	13(2)	5.9
2¼	57.2	S	oval	—	—	—	1	8(2)	3.6
2¼	57.2	S-12	trim	4	27	12.2	2	13(2)	5.9
2⅜	60.3	S-12	bugle	3	24	10.9	1	8(2)	3.6
2½	63.5	R	wafer	2	27	12.2	1	14(3)	6.4
2½	63.5	S-12	wafer	2	27	12.2	1	14(3)	6.4
2⅝	66.7	S-12	bugle	2.5	24	10.9	1	10(2)	4.5
2⅞	73.0	S	oval	—	—	—	1	14(2)	6.4
3	76.2	S-12	bugle	2	23	10.4	1	13(2)	5.9
3	76.2	R	wafer	1.5	23	10.4	.75	12(3)	5.4
3	76.2	S-12	wafer	1.5	23	10.4	.75	12(3)	5.4
3¾	95.3	S	oval	—	—	—	1	18(2)	8.2
TAPCON SCREW									
1¾	44.5	conc.	hex	1	10	4.5	—	—	—

*Also available in master cartons; (1) 8 pkgs. per ctn., (2) 4 pkgs. per ctn., (3) 2 pkgs. per ctn. (Cd) —cadmium plated. ** Large quantities available in special pallet packaging.

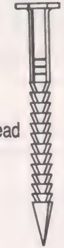
Gypsum Board Nails—Vastly improved since the relationship of wood shrinkage to nail popping was discovered. Nails have been developed to concentrate maximum holding power over the shortest possible length—notably the annular ring type nail which has about 20% greater holding power than a smooth-shank nail of the same length and shank diameter. However, under lengthy, extreme drying conditions, such as a cold dry winter or in arid climates, resultant wood shrinkage may cause fastener pops even with the shorter annular ring nail. However, severity of the "pop" will be less than with a longer nail.

As with screws, specification of the proper nail for each application is extremely important, particularly for fire-rated construction where nails of the specified length and diameter only will provide proper performance. When wood-frame gypsum panel systems are subjected to fire, nails on surface attain temperatures that tend to char the wood, thereby reducing their holding power. Nails used in gypsum construction should comply with performance standards of ASTM C514. Nails, except USG Matching Color Nails, are not available from U. S. G.

Hand pressure is applied to panel as nail is driven.

Selector Guide for Gypsum Board Nails(1)

fastener description(2)	fastener length		total thickness of surfacing materials(3)										approx. usage	
			in	1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/4	1-3/8		
	in	mm	mm	6.4	9.5	12.7	15.9	19.1	22.2	25.4	31.8	34.9	lb/1,000 ft²	kg/100m²
Annular Ring Drywall Nail 12½ ga. (2.50 mm) ¼" (6.35 mm) diam. head, med. diamond point	1¼	31.8		X	X	X							4.50	2.20
	1⅜	34.9					X						5.00	2.44
	1½	38.1						X					5.25	2.56
	1⅝	41.3							X				5.75	2.81
Same as above except 19/64" (7.54 mm) diam. head	1¼	31.8		X	X	X							4.50	2.20
	1⅜	34.9					X						5.00	2.44
	1½	38.1						X					5.25	2.56
	1⅝	41.3							X				5.75	2.81
	1¾	44.5								X			6.00	2.93
	2	50.8									X		7.00	3.42
12½ ga. (2.50 mm) 19/64" (7.54 mm) diam. head	1¼	31.8		X	X	X							4.50	2.20
	1⅜	34.9					X						5.00	2.44
	1½	38.1						X					5.25	2.56
	1⅝	41.3							X				5.75	2.81



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Selector Guide for Gypsum Board Nails[1] *continued*

fastener description[2]	fastener length		total thickness of surfacing materials[3]										approx. usage	
	in	mm	in / mm	1/4 / 6.4	3/8 / 9.5	1/2 / 12.7	5/8 / 15.9	3/4 / 19.1	7/8 / 22.2	1 / 25.4	1-1/4 / 31.8	1-3/8 / 34.9	lb/1,000 ft²	kg/100m²
Same as above except ¼" (6.35 mm) diam. head 														
14 ga. (2.03 mm)	1⅜ (4d)	34.9					X						3.50	1.71
13½ ga. (2.18 mm)	1⅝ (5d)	41.3						X					4.50	2.20
13 ga. (2.32 mm)	1⅞ (6d)	47.6								X			5.75	2.81
13½ ga. (2.18 mm)	2⅛ (7d)	54.0										X	7.50	3.66
Color Nails for TEXTONE Vinyl Panels 														
15½ ga. (1.71 mm) 3/32" (2.36 mm) diam. head	1⅜	34.9				X	X						2.00	0.98

[1] For wood framing 16" o.c., nails 8" o.c. for walls, 7" o.c. for ceilings.
[2] All nails treated to prevent rust with joint compounds or veneer finishes. Fire-rated assemblies generally require greater nail penetration; therefore, for fire-rated assemblies, use exact nail length and diameter specified for rated assembly (see Fire Test Report).
[3] In laminated double-layer construction, base layer is attached in same manner as single layer.

Adhesives and Sealants

Drywall adhesives make an important contribution to gypsum panel attachment where the finest room interiors are desired. Their use greatly reduces the nail or screw fastening otherwise required, thus saves labor on spotting and sanding—also minimizes nail pops and other fastener imperfections.

U.S.G. offers reliable, field-tested adhesives designed for professional use. Each is formulated to produce superior attachment, freedom from fastener imperfections and high-quality results. Recommended for laminating gypsum panels in multi-layer fire-rated or non-rated partitions and ceilings are **DURABOND Joint Compounds**—dry powder products, applied by spreader, requiring mixing and temporary fastening in application or **USG Ready-Mixed Joint Compound**—All Purpose or Taping. All provide tight bond when dry yet permit adjustment of panels after contact.

Commercially available adhesives in drywall stud, laminating, liquid contact and construction types meeting ASTM C557 are used in non-fire rated gypsum construction. These adhesives bridge minor irregularities in the base or framing, make it easier to form true joints and level surfaces. The use of adhesive adds strength to an assembly, reduces fasteners required, helps eliminate loose panels and nail pops.

DURABOND Joint Compounds—Dry, powder products to be mixed with water, used for laminating gypsum panels in multi-layer fire-rated or non-rated partitions and ceilings. Spreader-applied, require temporary fastening in application. Provide tight bond when dry, yet permit panel adjustment after contact. Meet Federal Specification SS-J-570B, Type I, Style 2; and ASTM C475.

USG Ready-Mixed Joint Compound—Taping or All Purpose—Vinyl-based compounds formulated to a creamy smooth consistency for fast spreader application. Offer ready-to-use convenience, eliminate extensive mixing and waste. Provide good bond and strength when dry. Use above grade; keep from freezing. Meets Federal Specification SS-J-570B, Type I, Style 3; and ASTM C475.

USG Acoustical Sealant—A highly elastic, water-base caulking compound for sealing sound leaks around partition perimeters, cutouts and electrical boxes. Pumpable and easily applied in beads or may be worked with a knife over flat surfaces such as the outside of electrical boxes. Provides excellent adherence to most surfaces. Highly resilient, permanently flexible, shrink and stain-resistant, long life expectancy.

Coverage—Laminating Adhesives

product (1)	type of laminating	approx. coverage (2) lam. blade notch spacing 2" o.c.	1½" o.c.
USG Ready-Mixed Joint Compounds	sheet	340	465
	strip	170	230
DURABOND Joint Compounds	sheet	184	246
	strip	93	123

(1) See Joint Compound Specifications for standard package sizes. (2) Coverage in lb./1000 ft.² of packaged product not including water necessary to achieve working consistency.

Joint Compounds

Today's complete U.S.G. joint compound line includes both ready-mixed and powder products in drying and hardening types. All are formulated without asbestos and therefore meet all OSHA and Consumer Product Safety Standards pertaining to asbestos. In addition to conventional joint finishing and fastener spotting, certain of these products are designed for repairing cracks, patching, spackling, back-blocking, texturing and for laminating gypsum panels in double-layer systems. Products comply with ASTM C475 and Federal Specification SS-J-570B, Type I, Style 1, 2 and 3.

advantages

In U.S.G. joint compounds, these qualities of superiority have been developed:

Non-Asbestos Formulations—Safe to handle and use; meet OSHA and Consumer Product Safety Standards.

Versatility—Job-tested compounds available in specialized types to meet finishing requirements.

Low Cost—High-quality products reduce preparation time, save application labor, prevent expensive callbacks.

Use of U.S.G. joint compounds brings the important added advantage of dealing with one manufacturer who is responsible for *all* components of the finished walls and ceilings—formulated in U.S.G. laboratories, manufactured in U.S.G. plants for maximum system performance.

general limitations

1. U.S.G. joint compounds are not compatible with and should not be intermixed with any other compounds.

2. For interior use only (except DURABOND Compounds); not recommended for laminating (except DURABOND Compounds and USG Ready-Mixed Compounds—All Purpose and Taping).

3. Protect bagged and cartoned products against wetting; protect ready-mixed products from freezing and extreme heat.

4. Each compound coat must be dry before the next is applied (except DURABOND Compounds), and completed joint treatment must be thoroughly dry before decorating.

5. U.S.G. joint compounds are not recommended for treating joints of Water-Resistant Gypsum Panels to be covered with ceramic or plastic tile (use SHEETROCK Brand W/R Compound).

6. To improve fastener concealment where gypsum panel walls and ceilings will be subjected to severe artificial or natural side lighting and be decorated with a water-based paint, apply a good quality alkyd (oil) based primer/sealer prior to decoration. However, when using this procedure, care should be taken to avoid roughening the surface paper if sanding is used to smooth the joint compound.

USG Ready-Mixed Joint Compounds

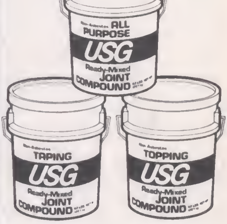
Ready-Mixed Joint Compounds are drying-type products which are vastly superior to ordinary ready-mixed compounds and are preferred for consistently high-quality work. These non-asbestos, vinyl-based formulations are specially premixed to a creamy, smooth consistency essentially free of crater-causing air bubbles. They offer excellent slip and bond, easy workability. Available for hand or machine-tool applications.

Limitation: must protect wet joints and container from freezing.

Three specialized products:

USG Ready-Mixed Joint Compound-Taping—A high-performance product for embedding tape and as a first fill coat over metal bead, trim and fasteners. Also used for laminating.

USG Ready-Mixed Joint Compound-Topping—A low-shrinkage, easily applied and sanded product recommended for sec-



ond and third coats over USG Ready-Mixed Taping and All Purpose Compounds. Also used for simple texturing or skim coating. Not suitable for embedding tape or as first coat over metal corners, trim and fasteners.

USG Ready-Mixed Joint Compound-All Purpose—Used for embedding, finishing, simple texturing and for laminating. Combines single-package convenience with good taping and topping characteristics. Recommended for finishing SHEETROCK Brand SW Gypsum Panel joints over DURABOND Compound; also for repairing cracks in interior plaster and masonry not subject to moisture.

USG Vinyl-Base Powder Joint Compounds

USG Powder Joint Compounds are top-quality, non-asbestos, conventionally drying products providing easy mixing, smooth application and ample working time. Designed for embedding tape; for fill coats and finishing over drywall joints, corner bead, trim and fasteners. Also used for simple texture finishes; will not cause alkali burning of paint. Included in line:

USG Joint Compound-Taping—Designed for embedding tape and for first fill coat on metal corner beads, drywall trims and fasteners; also used for patching plaster cracks. Offers excellent bond and resistance to cracking.

USG Joint Compound-Topping—A smooth-sanding material for second and third coats over taping or all-purpose compound. Produces excellent feathering and superior finishing results.

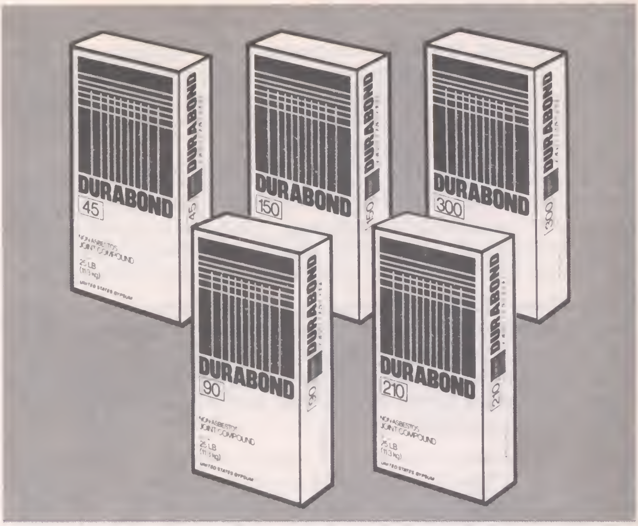
USG Joint Compound-All Purpose—Incorporates good taping and topping characteristics in a single product, for use where finest results of the specialized compounds are not necessary. Also has good texturing properties.

DURABOND Powder Joint Compounds

These hardening-type powder products provide faster finishing of drywall interiors, even under slow drying conditions. Rapid chemical hardening and low shrinkage permit one-day joint finishing and usually next-day decorating. Features exceptional bond; virtually unaffected by humidity extremes. Ideal for laminating double-layer systems, particularly fire-rated assemblies, and for adhering gypsum panels to sound deadening boards and to above-grade concrete surfaces. Excellent for skim coating and surface texturing and for filling, smoothing and finishing interior above-grade concrete. Also used to treat joints in exterior gypsum ceiling board and to embed tape and fill beads in veneer finish systems when rapid drying conditions exist.

Limitations: DURABOND Compounds are difficult to sand after drying and must be smoothed before complete hardening. Not to be applied over moist surfaces or surfaces likely to become moist, on below-grade surfaces, or on other surfaces subject to moisture exposure, pitting or popping.

DURABOND 210 Joint Compound—Preferred for embedding tape and metal accessories; also ideal for heavy fills because it



chemically hardens in 3 to 6 hours. Virtually unaffected by humidity.

DURABOND 90 Joint Compound—With a 1 to 2-hour hardening time, makes an ideal alternate to DURABOND 210 Joint Compound in applications where quicker finishing or laminating are desired. Required as prefill material for SW Gypsum Panels. Also used extensively for touch-up and patching; ideal for filling offsets and voids in poured concrete.

DURABOND 45, 150 and 300 Joint Compounds—Offer varied setting times of approx. 30 to 60 min., 120 to 180 min. and 240 to 360 min.

Joint Compound Selection

Choosing the right joint compound for a specific job requires an understanding of a number of factors: job conditions, shop practices, applicators' preferences, types of available joint systems, characteristics of products considered, and recommended product combinations.

Joint compound products are usually named according to function, such as taping, topping and all-purpose. *Taping* typically performs as the highest shrinking, strongest bonding, hardest sanding of the three compounds, and is used for embedding tape, fasteners, metal beads and trim. *Topping* usually is the lowest shrinking, easiest applying and sanding of the compounds for use in second and third coats; may occasionally be designed for texturing. *Taping and topping* are usually designed as companion products to give the highest quality workmanship. *All-Purpose* is generally a compromise of taping and topping and may be used as a texturing material.

types of joint compounds

Two-Compound Systems—Formulated for superior performance in each joint finishing step. Separate taping compounds develop the greatest bond strength and crack resistance. Separate topping compounds have the best sanding characteristics, lower shrinkage and smoothest finishing.

All-Purpose Compounds—Good performance in all joint finishing steps—do not have the outstanding bond strength, workability and sandability of separate taping and topping compounds. However, All-Purpose Compounds minimize inventories—avoid jobsite mix-ups—especially good for scattered jobs.

Ready-Mixed Compounds—Open-and-use convenience—save time and mistakes in mixing—minimum waste. Require no water supply at the job. Ready-Mixed Compounds have the best working qualities of all compounds—excellent performance plus factory-controlled batch consistency. Superior storage life compared to mixed powders.

These compounds *do* require heated storage. Should they freeze they can be slowly thawed at room temperature, mixed to an even viscosity and used without damaging effect. However, repeated freeze/thaw cycles cause remixing to become more difficult.

Powder Compounds—Have the special advantage of being storable (dry) at any temperature. If they are stored in a cold warehouse, however, they should be moved to a warm mixing room the day before they are to be mixed. Best results require strict adherence to proportioning of powder and water.

Specifications—U.S.G. Joint Compounds

product	container size	approx. coverage
USG Ready-Mixed Compound-Taping, Topping, All Purpose	61.7-lb. (28 kg) or 62-lb. (28.1 kg) can or pail; 50-lb. (22.7 kg), 55.1-lb. (25 kg) and 61.7-lb. (28 kg) carton	138 lb./1,000 ft.^{2} (67.4 kg/100m^2)
USG Powder Joint Compound-Taping, Topping, All Purpose	25-lb. (11.3 kg) bag	83 lb./1,000 ft.^{2} (40.5 kg/100m^2)
DURABOND Joint Compound-45, 90, 150, 210, 300	25-lb. (11.3 kg) bag	72 lb./1,000 ft.^{2} (35.2 kg/100m^2)

characteristics of joint compounds

The next consideration is the comparative performance characteristics of different U.S.G. joint compounds. The following chart rates all of the important characteristics.

Joint Compound Characteristics

conditions or requirements	product: DURABOND joint compounds (powder)	product: USG joint compounds (powder)	product: USG ready-mixed joint compounds
Hot, Dry Weather	Good	Good	Best
Cold, Wet Weather	Best	Fair	Good
Filling Concrete Surfaces	Best	Good	Good
Patching Fine Cracks	Good	Good	Best
Large Fills	Best	Good	Good
Lowest Applied Cost	Good	Good	Best
Easiest Sanding	N/R	Good	Best
One-Day Finishing	Best	N/R	N/R
Machine Appl.	N/R	Good	Best

N/R—not recommended.

conditions or requirements	product: DURABOND joint compounds (powder)	product: USG joint compounds (powder)	product: USG ready-mixed joint compounds
Texturing	Good	Good	Best
Strength	Best	Good	Good
Bond	Best	Good	Good
Resistance to Shrinkage	Best	Good	Good
Slip	Good	Good	Best
Mixed Life	N/R	Good	Best
Container Life	Good	Good	Best
Cratering	Good	Good	Best
Hardening or Drying Time	Best	Good	Good
Edge Crack Resistance	Good	Good	Best
Check Crack Resistance	Best	Good	Good
Paint Base	Fair	Good	Best

Joint System Recommendations

The last step in the selection process involves putting together the best combinations of products to form complete systems. The following chart shows recommended combinations.

Selector Guide for Joint Systems[1]

first coat: embedding tape; first coat over beads; spotting fasteners	second coat: filling over tape, beads and fasteners	third coat: finishing over tape, beads and fasteners
1. DURABOND 210 Compound	DURABOND 150 Compound	USG Ready-Mixed Compound-Topping or All Purpose
2. USG Ready-Mixed Compound-Taping or All Purpose	USG Ready-Mixed Compound-Topping or All Purpose	USG Ready-Mixed Compound-Topping or All Purpose
3. USG Powder Compound-Taping	USG Powder Compound-Topping	USG Powder Compound-Topping
4. USG Powder Compound-All Purpose	USG Powder Compound-All Purpose	USG Powder Compound-All Purpose
5. DURABOND 300 Compound	DURABOND 210 Compound	USG Powder Compound-All Purpose

(1) Listed in sequence of highest-quality results.

Reinforcing Tapes

From the originator of modern joint finishing, U.S.G. reinforcing tapes add strength and crack resistance for smooth concealment at flat joints and inside corners. Two products—both quickly and easily applied—are available for specialized uses: paper tape for treatment with joint compounds; glass-fiber tape for veneer finishes.

PERF-A-TAPE Reinforcing Tape—A special high-strength fiber tape for use with U.S.G. joint compounds in reinforcing joints and corners in gypsum drywall and veneer finish interiors. Exceptional wet and dry strength; resists stretching, wrinkling and other distortions; lies flat and resists tearing under tools. The wafer-thin tape is lightly sanded for increased bond and lies flat for easy concealment on next coat. Precision-processed with positive center creasing, which simplifies application in corners; uniform winding provides accurate, trouble-free attachment to angles and to flat joints.

Preferred for its consistent high performance in gypsum drywall finishing, PERF-A-TAPE with DURABOND Joint Compounds is also used with veneer finish systems. Available nom. 2¹⁄₁₆″ (52mm) wide in 60-ft., 250-ft., 500-ft. rolls. Approx. coverage: 370 lin. ft. tape per 1,000 sq. ft. panels.

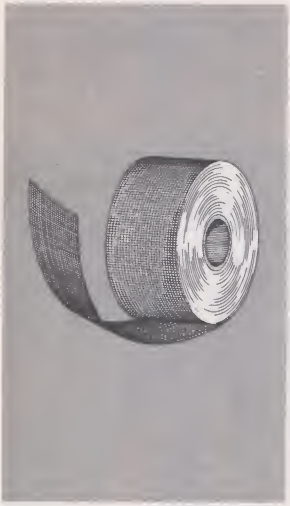
PERF-A-TAPE is designed for both embedding by hand (left) and application with mechanical taping tool (above). Joint is covered with thin layer of compound before taping.

IMPERIAL Tape—A strong, glass-fiber tape used to conceal and reinforce joints and interior angles of IMPERIAL Gypsum Base and USG R.H. Base prior to veneer finishing with IMPERIAL Basecoat, IMPERIAL Finish and DIAMOND Interior Finish. High-tensile strength glass fibers are woven into an open mesh, coated with binder and slit to roll width.

The open weave of IMPERIAL Tape (100 meshes per sq. in.) provides excellent reinforcing and keying of plaster to resist cracking. The glass fibers lay flat and minimize stretching for wrinkle-free attachment without springback or distortion. Spirally woven long strands and the binder coating reduce edge raveling and fraying, keep loose threads from defacing finished surfaces. Tape flexes readily to permit fast application to flat joints and corners. Available in two types:

Type P with pressure-sensitive adhesive backing. Selected for quick, self-stick hand application; saves installation time and fastener cost.

Type S with plain back, fastened with staples. Lower in cost than Type P.



Both types of glass-fiber IMPERIAL Tape are quickly applied—Type S with 3/8″ staples at staggered 24″ intervals (above), self-stick Type P by light hand pressure and bonding with finishing knife or trowel (right). Use of Type P Tape cuts taping time up to 50%, simplifies embedding and saves cost of staples.

Available $2\frac{1}{2}''$ wide in 300-ft. rolls, 12 rolls per ctn. Approx. coverage: 370 lin. ft. tape per 1,000 sq. ft. gypsum base. *Note:* Glass fiber tape should not be used with joint compounds.

Veneer Finishes

Veneer finishes offer the opportunity to trim days from interior finishing schedules and provide strong, highly abrasion-resistant surfaces. These products are designed for one- or two-coat work over gypsum bases or directly to concrete block or properly prepared monolithic concrete. Formulated for hand or machine application (IMPERIAL Finish and DIAMOND Interior Finish—hand only), they provide a thin, lightweight veneer that sets rapidly.

advantages

Rugged, Abuse-resistant Surfaces—High-strength IMPERIAL Finishes (3,000 psi compressive strength) provide hard, durable interiors that require minimum maintenance.

Quicker Completion/Faster Occupancy—Veneer finishes apply rapidly, set fast, dry quickly to save days in finishing interior walls and ceilings. DIAMOND Interior Finish can be decorated in 24 hrs. with breather-type paint or left undecorated if desired.

Competitive Costs—Veneer finishes are easily applied and cover more area per ton than conventional plasters. Joints and interior angles are pre-set with the same veneer finish that goes on the walls and ceilings, eliminating need for joint compound and resultant drying time.

Easily Decorated—Veneers are readily finished in smooth-trowel, float or texture surfaces. The hard, smooth surface is decorated easily and economically with paint, fabric, wallpaper or texture.

Versatile—A wide choice of assemblies is available to meet design requirements. Fire and sound-rated systems for wood or steel framing, hard and abuse-resistant surfaces for high-traffic areas, electrically heated ceilings.

products available

IMPERIAL Basecoat—For use as a basecoat in two-coat veneer application finished with proper lime or gypsum finishes. Can be applied to either IMPERIAL Gypsum Base, directly to concrete block, or over a bonding agent on monolithic concrete. Formulated as the basecoat for high-strength IMPERIAL Finish, gauged lime putty, DIAMOND Interior Finish, STRUCTO-GAUGE-lime-smooth trowel, or Keenes-lime-sand float finishes. Available in hand- and machine-application formulations. Complies with ASTM C587 and Federal Specification SS-P-00402B, Type VI. Available in 80-lb. bags.

IMPERIAL Finish Plaster—For single-coat application composed of scratch coat and immediate doubling back directly over

When abraded 2,500 cycles by 25-lb. weighted wire brush in laboratory test, IMPERIAL Veneer finish showed virtually no penetration—proof of outstanding abrasion resistance.

special IMPERIAL Gypsum Base, glass-fiber tape or PERF-A-TAPE and DURABOND Compound or over IMPERIAL Basecoat Plaster in two-coat system. Available for hand application—provides a smooth-trowel or float or spray-texture finish ready for decoration. Complies with ASTM C587 and Federal Specification SS-P-00402B, Type VI. Available in 80-lb. bags.

IMPERIAL Finishes—Coverage

product	ft²/ton		m²/ton (metric)[1]	
	gypsum base	masonry	gypsum base	masonry
IMPERIAL Basecoat	3250–4250	2700–3600	335–435	275–370
IMPERIAL (1-coat) Finish	3500–4000	not recommended	360–410	not recommended
IMPERIAL (2-coat) Finish	3200–3600	not applicable	330–370	not applicable

(1) Coverage rounded to nearest 5m².

DIAMOND Interior Finish—A white finish formulated for hand application directly to IMPERIAL Gypsum Base or over a bonding

agent on monolithic concrete. Also suitable in a two-coat system over IMPERIAL Basecoat or a sanded gypsum basecoat. Applied to a nom. 1/16″ thickness, this finish is *unaggregated* for a smooth or skip-trowel finish; may be aggregated for float or other textures; must be aggregated with one-half to one part fine silica sand for application to monolithic concrete. Fast-applying; under ideal drying conditions, can be decorated in 24 hours with breather-type paint. Not recommended for use over portland cement basecoat or masonry surfaces. Complies with ASTM C587 and Federal Specification SS-P-00402B, Type VI. Available in 50-lb. bags.

DIAMOND Interior Finish should be applied only to IMPERIAL Gypsum Base having blue face paper. Faded base must be treated with alum solution or a bonding agent before finish is applied to prevent possible bond failure. See Chapter 2, General Product Application, for specifics.

DIAMOND Interior Finish is also suitable for use with electric cable ceilings. Allows higher operating temperatures than with other products, provides more heat transmission and greater resistance to heat deterioration. Finish is job-sanded and hand-applied 3/16″ thick to cover cable. A finish coat of the same material is applied 1/16″ to 3/32″ thick to bring the total plaster thickness to 1/4″. Applied over special USG R.H. Base attached to wood joists, to metal furring channel or suspended metal grillage; or over a bonding agent directly to monolithic concrete ceilings (3/8″ finish thickness required).

DIAMOND Interior Finish—Coverage

conventional walls and ceilings

surface applied to	neat		sand float finish sanded 1:2(1)		heavy texture finish sanded 1:1(1)	
	ft²/ton	m²/ton(2)	ft²/ton	m²/ton(2)	ft²/ton	m²/ton
IMPERIAL Gypsum Base	6000	610	4660	475	3500	355
IMPERIAL Basecoat	5500	560	4330	440	3250	330
Sanded RED TOP Basecoat	5000	510	4000	410	3000	305
monolithic concrete	5500	560	4330	440	3250	330

electric cable heat ceilings

surface applied to	3/16″ fill coat sanded 1:1(1)		1/16″ finish coat sanded 1:4(1)		1/16″ finish coat sanded 1:1(1)	
	ft²/ton	m²/ton(2)	ft²/ton	m²/ton(2)	ft²/ton	m²/ton(2)
USG R.H. Base or monolithic concrete	2300	235	5000	510	3250	330

(1) Coverage based on one ton of aggregated mixture (combined weight of sand and DIAMOND Finish).
(2) Coverage rounded to nearest 5m² per metric ton.

Interior Drywall Finishes

U.S.G., the leader in wall and ceiling finish coatings, offers the industry's broadest line. These outstanding products offer finishes ranging from smooth monolithic surfaces to deeply sculptured textures.

concrete coatings

COVER COAT Compound—A vinyl-base product, formulated for filling and smoothing monolithic concrete ceilings, walls and columns located above grade—no extra bonding agent is needed. Supplied in ready-mixed form (sand can be added), easily applied with drywall tools in two or more coats. Dries to a fine white surface usually making ceiling painting unnecessary. Also can be used for embedding tape and for first coat over metal bead and trim.

Limitations: not to be applied over moist surfaces or surfaces likely to become moist (from condensation or other source), on ceiling areas below grade, on surfaces that project outside the building, or any area that might be subject to moisture, freezing, efflorescence, pitting or popping.

DURABOND Joint Compounds—These hardening-type compounds are ideally suited to fill offsets and voids left in concrete. They produce an extremely hard finish in various shades of white. Overpainting may be required.

Where deep fills are required, DURABOND Compounds are especially recommended for the first coat, then followed by COVER COAT Compound. This practice minimizes check cracking.

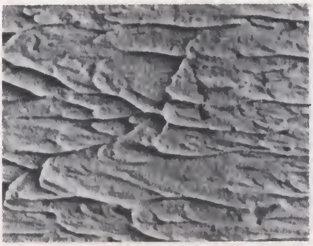
Limitations: same as for COVER COAT Compound.

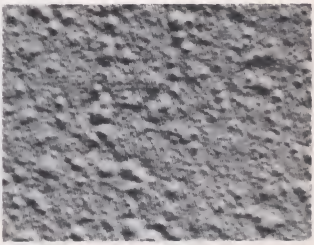
interior texture finishes

Powder texture products are: USG Multi-Purpose Texture Finish; USG Spray Texture Finish; USG Texture XII Drywall Surfac-

er; IMPERIAL QT Spray Texture Finishes; USG Powder Joint Compounds-All Purpose and Topping.

USG Multi-Purpose Texture Finish—An economical, unaggregated, non-asbestos powder product, to be mixed with water for desired texturing consistency. Excellent for producing a variety of light to medium-light textures on drywall or other interior surfaces. Textured effect obtained by brush, roller or spray application. Helps conceal minor surface defects; dries to a sparkling white finish usually overpainted on walls, can be left unpainted on ceilings.

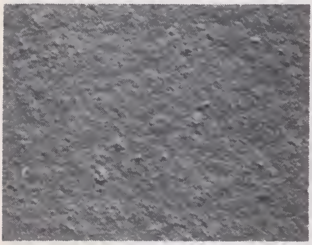


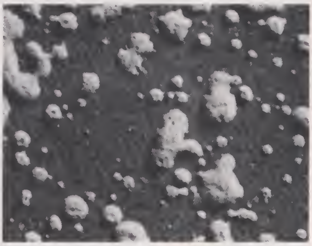


Variety of effects obtained with Multi-Purpose Texture Finish include (clockwise from above) bold shadowing with roller application, medium-light finish applied by spray, lightly stippled surface applied with small brush or roller-stippler. Material also can be scored to resemble block, tile or cut stone outlines.

USG Spray Texture Finish—A non-asbestos product available in aggregated and unaggregated forms for texture variety on most interior wall surfaces. Produces light spatter and fog-and-spatter finishes; light "orange peel" texture with spray application. Eliminates touch-up of overspray on finished ceilings.

Stays mixed—superior wet and dry bond assures good holdout of finish film over dry joints. Often applied in two coats with second coat producing texture such as fog-and-spatter finish. Dries to a soft white surface with good concealment. Should be overpainted when dry.

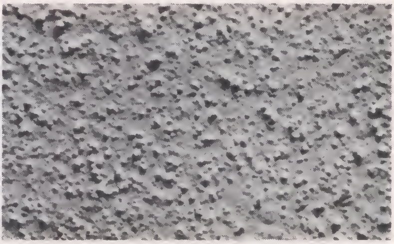




Surface designs available with Spray Texture Finish range from rapidly applied soft texture, left, to random spatter finish shown at right. Latter is often applied as second of two coats.

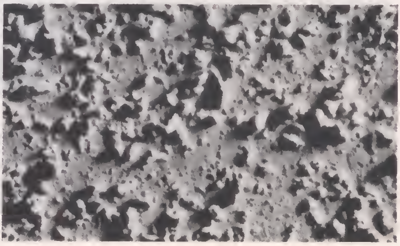
USG Texture XII Drywall Surfacer—A non-asbestos white coating for spray application. Available in aggregated form to achieve a sand-finish effect; in unaggregated form for a smooth finish on interior gypsum panel surfaces. Conceals minor surface defects—provides a uniform texture with good hide. Provides an excellent base for any latex- or oil-base paint, or can be left unpainted on ceilings.

Closeup view shows typical sand-effect finish obtained with aggregated Texture XII Drywall Surfacer. In application, fan technique is used on walls, cross-spray on ceilings.



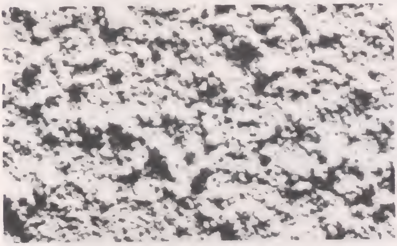
IMPERIAL QT Spray Texture Finish (P-Medium) (PC-Coarse) (PS-Super Coarse)—A non-asbestos powder product with polystyrene aggregate, available in three textures. Produces a handsome simulated acoustical ceiling finish but with no acoustical correction. Requires only addition of water and short

Example of striking texture produced by P-Medium IMPERIAL QT Finish. Material dries to exceptional whiteness and is usually left unpainted on ceilings.



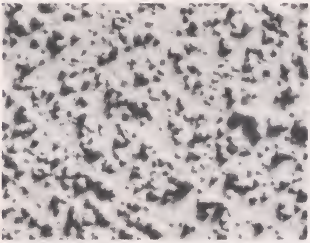
soaking period at job site. Produces excellent bonding qualities for application to gypsum panels, concrete, plaster or wood. High wet- and dry-hide masks minor surface defects. Dries to exceptional whiteness, usually left unpainted but may be over-painted if desired.

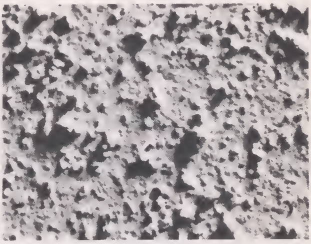
IMPERIAL QT Spray Texture Finish (Perlite-Fine)—A non-asbestos product with perlite aggregate that produces a rich textured appearance on ceilings. Provides no acoustical correction. Used over many interior surfaces—new or old concrete, gypsum panels, plaster, wood, even metal pipes. In powder form, easily mixed with water. Requires short soaking period—once mixed, stays mixed. Spray-applied for fast, low-cost coverage. Good pumpability with minimum fallout. Conceals minor surface defects. Dries to a hard, white finish that can be painted.



Eye-pleasing texture is IMPERIAL QT Perlite-Fine finish. Hard, white finish can be overpainted by spray application; tinting is not recommended.

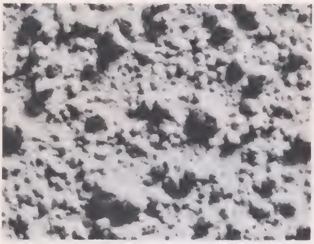
IMPERIAL QT Spray Texture Finish (V-Medium) (VC-Coarse)—A non-asbestos product formulated with vermiculite aggregate for a choice of medium- or heavy-texture ceiling surfaces. Produces no acoustical correction. Used over most interior surfaces—new or old concrete, gypsum panels, plaster, and primed metal. Both types in powder form, easily mixed with water for spray application. Covers most minor surface defects, dries to an off-white surface that may be painted.

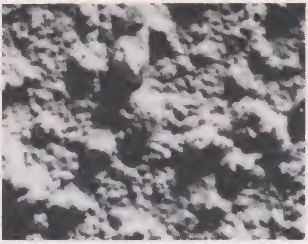




V-Medium finish at left, rugged VC-Coarse texture at right are typical surface effects. Both offer attractive contrast with smooth-finish elements used in interior.

IMPERIAL QT Spray Texture Finish (ST-Medium) (STC-Coarse)—A non-asbestos aggregated powder providing a bold surface with a fine aggregated background. Resembles an acoustical ceiling finish but with no acoustical correction. Mixed with water at jobsite, requires short soaking period—once mixed, stays

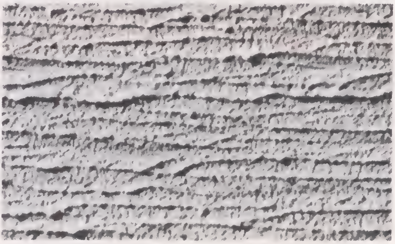




Massive vermiculite aggregate on fine perlite background highlights ST-Medium and STC-Coarse finishes.

mixed. Provides good pumpability for spray application. Bonds to most construction surfaces. Levels minor surface irregularities, masks surface defects, resists fissure cracking in normal thicknesses. Crisp white finish usually is left unpainted but may be overpainted.

USG Powder Joint Compound (All Purpose or Topping)—Easy-mixing, smooth-working products that can be used to produce attractive light to medium textures. Color is white but may vary in degree of whiteness. Surfaces should be painted. Applied with brush, roller or trowel.



Simple roller-applied texture is obtained with vinyl-base USG Powder Joint Compounds. Same products thus can be used for both joint finishing and texturing on job.

Paste texture products are: USG Hi-Build Ready-Mixed Texture Finish, USG Ready-Mixed Texture Compound, USG Texture I, USG Texture II, TEXOLITE Sanded Paste Stipple, TEXTONE Light Sand Texture, TEXTONE Coarse Ceiling Texture, TEXTONE Smooth Design Texture, TEXTONE Interior/Exterior Stucco Texture, DURACAL Exterior/Interior Spray Texture Finish, USG Ready-Mixed Joint Compounds-All Purpose and Topping.

USG Hi-Build Ready-Mixed Texture Finish—A white, non-asbestos, latex-type material for interior surfaces, offers super-thickness—up to ⅜″—with the speed of a ready-mixed formulation. Develops a tough, durable surface with minimal to no fissuring. Stucco or Travertine textures can be readily achieved. Allows greater pattern versatility not possible with thinly applied products. Can be job-mixed with a variety of aggregates for greater coverage and range of texture effects.

USG Ready-Mixed Texture Compound—A white, non-asbestos,

latex-type material for interior surfaces, offers the speed and convenience of ready-mix formulation. Provides *extra* tough and durable finish up to 1/16″ thick. Attractive textures, such as stomp or crow's foot, Monterey or knock-down, orange peel, fog coat and others can be readily created with roller, brush or spray gun. Can be left unpainted on remote non-contact surfaces, or overpainted for protection against soiling, if desired.

USG Texture I—A latex material that produces a light sand-finish effect with a slight under-texture. Color is white and does not require overpainting. One coat of this ready-to-use paint usually gives exceptional results. It covers fine cracks and most surface spots and blemishes. Applied with brush or roller.

Texture I may be thinned *sparingly with water.* Also, it may be tinted with USG COLORTREND* Machine Colorants, but is not balanced to exactly match COLORTREND EXCEPTIONALE* colors.

USG Texture II—A latex material that produces a fine texture ranging from "orange peel" to a moderate ripple, depending on method of application, tools used and thickness of film. Color is white and does not require overpainting, usually a one-coat application is sufficient. May be applied with roller, brush followed by roller, or can be sprayed for special effects.

Texture II should not be thinned. It may be tinted with USG COLORTREND Machine Colorants, but is not balanced to exactly match COLORTREND EXCEPTIONALE colors.

TEXOLITE Sanded Paste Stipple—A vinyl-acrylic material that produces a sand-effect stipple. Wall applications should be overpainted. Ceilings can be left unpainted provided they are given a full, thick uniform coating. Applied with brush or roller. Sanded Paste Stipple can be thinned with water. Tinting is not recommended.

TEXTONE Light Sand Texture—A ready-to-use, fine sand aggregated, vinyl-acrylic paste texture for interior surfaces. Helps conceal voids, pores and minor defects. Swirl patterns and other designs produced with paint or texturing brush or roller. White, tintable to pastel colors, washable when overpainted.

TEXTONE Coarse Ceiling Texture—Produces heavy-stipple, aggregated texture with roller application. Ready-to-use, heavy-bodied, vinyl-acrylic paste with medium aggregate readily conceals minor defects on interior ceilings. White. May be left unpainted or overcoated with TAL Latex Wall Paint.

TEXTONE Smooth Design Texture—A non-aggregated, heavy-bodied, vinyl paste for interior surfaces. Job-thinned with water for desired texture—smooth, "crow's foot", roller stipple or spray/spatter pattern. White. For maximum durability and deeper colors, overpaint with TAL Latex Wall Paint.

TEXTONE Interior/Exterior Stucco Texture—A heavy-bodied, ready-to-use, vinyl-acrylic paste with medium aggregate. Helps

*Trademark of Tenneco Chemicals, Inc., Cal-Ink Div.

conceal minor surface defects, provides extremely durable white texture on masonry, concrete, primed metal and wood—most interior and exterior substrates. Tintable to pastel colors, overpaint for deeper colors.

DURACAL Exterior/Interior Spray Texture Finish—A thick, ready-to-use latex aggregated coating for spray application to old or new primed wood, metal, concrete surfaces; asbestos siding or in USG Exterior Ceiling Board construction. Heavy texture hides minor surface imperfections. Flexible, mildew and water resistant coating which dries tack-free in about 2 hours when applied as recommended. White and special colors in 100-gal. quantities or more. Meets performance requirements of Fed. Spec. TT-C-555B, Type 2.

USG Ready-Mixed Joint Compounds (Topping or All Purpose)—Virtually ready to use, these products will produce textures ranging from light to medium depending upon method of application. Color is white but may vary. Surfaces should be painted. Applied with brush, roller or trowel.

Tables on the following pages give complete information on texture uses and the finishes produced.

Specifications—U.S.G. Interior Texture Finishes[1]

product	container		coverage[2]	
	size	type	ft^2/lb	m^2/kg
Multi-Purpose	25 & 50 lb. (11.3 & 22.7 kg)	bag	15–20	3.1–4.1
Spray Texture	25 & 50 lb. (11.3 & 22.7 kg)	bag	20–50	4.1–10.2
Texture XII	25 lb. (11.3 kg)	bag	20–35	4.1–7.2
IMPERIAL QT (P, PC & PS)	32, 40 & 50 lb. (14.5, 18.1 & 22.7 kg)	bag	6–8	1.2–1.6
IMPERIAL QT (Perlite-Fine)	40 lb. (18.1 kg)	bag	8 max.	1.6 max.
IMPERIAL QT (V & VC)	40 lb. (18.1 kg)	bag	8 max.	1.6 max.
IMPERIAL QT (ST & STC)	40 lb. (18.1 kg)	bag	8 max.	1.6 max.
Texture I	1 & 5 gal. (3.8 & 18.9 L)	can	200[1]	4.9[2]
Texture II	1 & 5 gal. (3.8 & 18.9 L)	can	200[1]	4.9[2]
Sanded Paste Stipple	1 & 5 gal. (3.8 & 18.9 L)	can	200[1]	4.9[2]
USG Hi-Build Ready-Mixed Texture	61.7 lb. (28 kg)	pail	3.6 max.	0.7 max.
USG Ready-Mixed Texture Compound	50 lb. (22.7 kg)	carton	8 max.	1.6 max.
TEXTONE Light Sand Texture	1, 2 & 5-gal. (3.8, 7.6 & 18.9L)	pail	200[3]	4.9[4]
TEXTONE Coarse Ceiling Texture	1, 2 & 5-gal. (3.8, 7.6 & 18.9L)	pail	30–60[3]	0.7–1.4[4]
TEXTONE Smooth Design Texture	1, 2 & 5-gal. (3.8, 7.6 & 18.9L)	pail	40–125[3]	1.0–3.0[4]
TEXTONE Int./Ext. Stucco Texture	1, 2 & 5-gal. (3.8, 7.6 & 18.9L)	pail	30–60[3]	0.7–1.4[4]
DURACAL Ext./Int. Spray Texture	5-gal. (18.9L)	pail	40–50[3]	1.0–1.2[4]

(1) Products described here may not be available in all geographic markets. The product data may also vary among plants. Consult your local U.S.G. sales office or representative for information. (2) Coverage, as shown here, is intended to provide a relative comparison between products when mixed and applied according to directions—not to provide a figure for job estimating. Coverage can vary widely depending on factors such as condition of substrate, amount of dilution, spray techniques and procedures, thickness and uniformity of coating, and market preferences in texture appearance. (3) ft^2/gal. (4) m^2/L

Selector Guide for U.S.G. Texturing Materials

product	finish appearance	special features	application
USG Multi-Purpose Texture Finish (powder)	Light to medium textures, medium stipple	(1) Excellent finishes in light to medium textures (2) Produces sharp, well-defined stipple (3) Conceals minor surface imperfections	Brush, roller or spray (surface should be primed and sealed)
USG Spray Texture Finish (powder)	Wide range possible, from light texture to "orange peel" and spatter	(1) Variety of texture effects possible by varying spray and material pressure (2) Roller gives rolled, stipple texture	Spray recommended (may be brushed or rolled—surface should be primed and sealed)
USG Texture XII Drywall Surfacer (powder)	Sand-finish effect	(1) Good hiding of blemishes (2) Excellent paint base (3) Very hard surface	Spray only (surface should be primed and sealed)
IMPERIAL QT Spray Texture Finish (powder)	"Acoustical finish" appearance. Aggregated texture in various degrees of coarseness: super coarse, coarse, medium and fine	(1) Crisp white finish (2) High bonding qualities (3) Good hiding of blemishes	Spray only (surface should be primed and sealed)
USG Texture I (paste)	Slight sand-finish effect with light under-texture	(1) Ready-to-use (2) Covers fine cracks, most spots and blemishes	Brush or roller
USG Texture II (paste)	Flat finish, ripple effect	(1) Ready-to-use (2) "Orange peel" to moderate ripple texture (3) Helps conceal moderate imperfections	Brush, roller or spray
TEXOLITE Sanded Paste Stipple (paste)	Low-sheen stipple, sand-effect background	(1) Ready-to-use (2) Helps conceal moderate imperfections	Brush or roller

USG Hi-Build Ready-Mixed Texture (paste)	Stucco, Travertine, other thick textures without fissuring. Texture range expanded with aggregate addition.	(1) Ready-to-use (2) May be job-aggregated (3) Super-thick textures in one coat	Trowel, roller or brush
USG Ready-Mixed Texture Compound (paste)	Attractive textures—stomp, or crow's foot, Monterey or knock-down, orange peel, fog-coat, etc.	(1) Ready-to-use (2) Excellent hide, white (3) Good bonding, easily pumped	Roller, brush or spray
TEXTONE Light Sand Texture (paste)	Fine texture—sand aggregate; swirl or other brush patterns.	(1) Ready-to-use (2) Covers cracks, fills pores (3) One-coat, no drip application	Brush or roller
TEXTONE Coarse Ceiling Texture (paste)	Heavy-bodied—medium finish	(1) Ready-to-use (2) Helps conceal moderate imperfections	Brush or roller
TEXTONE Smooth Design Texture	Heavy-bodied, smooth texture Ideal for personalized decorative patterns.	(1) Ready-to-use (2) One-coat application (3) Draws out smoothly	Brush, roller or trowel
TEXTONE Int./Ext. Stucco Texture	Heavy-bodied—coarse aggregate	(1) Ready-to-use (2) Interior or exterior (3) Low odor—vinyl-acrylic	Roller or brush
DURACAL Ext./Int. Spray Texture (paste)	Thick, heavy texture, white or pastel colors	(1) Ready-to-use (2) Helps cover minor imperfections (3) Mildew/water-resistant	Spray only
Joint Compounds—All Purpose or Topping (paste and powder)	Light to medium textures and patterns	(1) Economical (2) Only one material needed on joint treatment jobs	Spray, brush, roller or trowel (surface should be primed and sealed)

chapter 2

drywall and veneer construction

construction standards—

general product application

(continued on next page)

general planning procedures

In most instances, job planning requirements and the application techniques used for the installation of large-size gypsum board apply equally to gypsum panels and gypsum bases. For that reason *the term "gypsum board" is used throughout this chapter wherever the recommendations apply to both types of products.* Only where the requirements differ (such as in frame spacing limitations) are the products treated separately.

Planning the Job

Advance planning by the wall and ceiling contractor can mean savings in time and material cost and result in a better-appearing job. Proper planning achieves the most effective use of materials, elimination of unnecessary joints, and the placement of necessary joints in the least conspicuous locations. One gypsum board should span the entire length or width of the wall or ceiling, if possible. By using the longest practical board lengths obtainable, end joints are kept to a minimum. Where they do occur, end joints should be staggered.

In double-layer construction, end joints in the face layer must be offset at least 10″ from parallel joints in the base layer. Layout of the base layer must be planned to accommodate this offset and still provide optimum joint-finishing conditions and efficient use of materials in the face layer.

Estimating Materials

Gypsum Board—From practical experience, professional estimators have developed methods for determining footage required to complete various types of jobs. Basically, these methods stem from the simple principle of "scaling a plan," and determining the length and width and ceiling height of each room on the plan. Frequently, door and window openings are "figured solid" with no openings considered. Exceptions may be large picture windows and large door openings. From these dimensions the estimator determines the square footage of each room. The footage of each room is added to determine total footage required. From these figures the number of gypsum boards needed may be determined. (Refer to Chapter 1—Product Standards—for available lengths of each panel.)

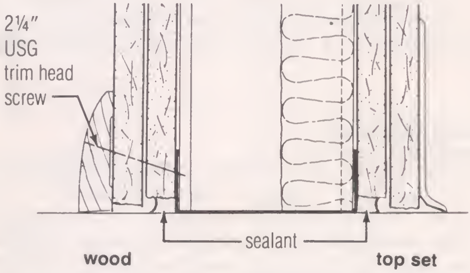
Screws—For single-layer application to 16″ o.c. wood framing, approx. 1,000 USG Type W Screws are required per 1,000 ft.^{2} of gypsum board; approx. 850 for 24″ o.c. framing.

Fastener usage for other assemblies varies with the construction and spacing. See system descriptions, Chapter 3.

Nails—Usage for nails is shown in the Selector Guide for Gypsum Board Nails, Chapter 1.

Acoustical Sealant—The approx. lin. ft. of bead realized per gal. of USG Acoustical Sealant is: 400 for ¼″ bead, 180 for ⅜″ bead, 100 for ½″ bead.

To prevent flanking and loss of the sound-control characteristics of rated partitions, USG Acoustical Sealant should be used at all wood and steel floor runners (detailed below) to seal bottom edge of gypsum board. Caulking at possible leaks in all U.S.G. Systems is required to obtain published sound ratings.



Adhesive—The following table shows the amount of adhesive needed per 1000 ft.^{2} of laminated board surface:

Coverage—Adhesives for Lamination

product	application	approx. quantity lb/1000 ft² lam. blade notch spacing 2"	1½"	kg/100 m² 50 mm	38 mm
USG Ready-Mixed Joint Compound	Strip lam.	170	230	83	112
	Sheet lam.	340	465	166	227
DURABOND Joint Compound	Strip lam.	93	123	45	60
	Sheet lam.	184	246	90	120

Joint Treatment—Gypsum Panels—Approx. 138 lb. of ready-mixed or 83 lb. of drying powder joint compound, or 72 lb. of hardening powder compound and 370 ft. of PERF-A-TAPE Reinforcement are required to finish 1,000 sq. ft. of gypsum panels.

Joint Treatment—Gypsum Base—For regular application, approx. 370 lin. ft. of either Type "P" or Type "S" IMPERIAL Tape is required per 1,000 sq. ft. of base surface.

For alternate application, approx. 370 lin. ft. PERF-A-TAPE Reinforcement and 72 lb. of DURABOND Joint Compound are required per 1,000 sq. ft. of surface.

general job conditions

Handling and Storage

When drywall and veneer construction moved into high-rise buildings, it brought with it the new challenge of moving large gypsum boards from the ground to the point of use, stories above. Inefficient materials-handling at the job site can add cost

and reduce profit. Time and money savings can be substantial when correct handling procedures are used.

Your U.S.G. representative can help in determining job-site handling costs and methods suited to particular job conditions.

Gypsum board products should be ordered for delivery several days in advance of installation. Materials stored on the job for a long period of time are subject to damage. Gypsum boards, like millwork, must be handled with care to avoid damage. Since joint compounds and veneer finishes are subject to aging, they must not be stored for extended periods.

Board should be placed inside under cover and stacked flat on a clean floor in the centers of the largest rooms. It is often desirable to place the necessary number of boards in the location where they will be used. All materials used on the job should remain in their packaging until ready for actual use.

Gypsum boards intended for use on ceilings should be placed on top of pile for removal first. Avoid stacking long lengths atop short lengths.

All successful veneer finish jobs require adequate equipment: power mixers, mortar boards, scaffolding and tools. Ample scaffolding should be provided. Rather than ship all veneer finish to the job at one time, fresh material should be sent to the job every few days as needed. Plaster stored for long periods is subject to damage, variable moisture conditions and aging that probably will produce variations in setting time and create performance problems.

Store veneer products inside, in a dry location and away from heavy traffic areas. Stack bags on planks or platforms away from damp floors and walls. Protect metal corner beads, casing beads and trim from being bent or damaged. All materials used on the job should remain in their packaging until used.

Environmental Conditions

For gypsum drywall, in cold weather (outdoor temperatures less than 55°F or 13°C), controlled heat in the range of 55° to 70°F (13° to 21°C) must be provided. This heat must be maintained both day and night, 24 hours before, during and after entire gypsum panel joint finishing and until the permanent heating system is in operation or the building is occupied.

Ventilation should be provided to eliminate excessive moisture. In glazed buildings, this may be accomplished by keeping double-hung windows open approx. 2″ top and bottom (or side-pivoted windows approx. 4″) to provide air circulation. In enclosed areas lacking in natural ventilation, temporary circulators should be used. Under slow drying conditions, allow extra drying time between coats of joint compound. Avoid drafts during hot, dry weather to prevent too rapid drying.

For veneer finishes—Maintain a comfortable working temperature (about 55°F or 13°C) and air circulation at a minimum level for at least 24 hours prior to, during, and following application until finish is completely dry. This prevents rapid drying and possible shrinkage, poor bond, chalky surfaces or cracking.

Sustained high humidity can cause board on ceilings to sag, especially when heavy insulation and water-based texturing materials are used. The weight of overlaid unsupported insulation should not exceed 1.3 psf for ½″ thick board with frame spacing 24″ o.c.; 2.2 psf for ½″ board on 16″ o.c. framing and ⅝″ board 24″ o.c.; ⅜″ thick gypsum panels must not be overlaid with unsupported insulation. A vapor retarder should be installed in all exterior ceilings, and the plenum or attic space properly vented. In winter or cold climates, a polyethylene vapor retarder should not be used unless the insulation is installed prior to ceiling panels.

Water-based texturing materials applied to ceilings should be completely dry before insulation and vapor retarder are installed. Under most conditions, drying takes several days; i.e., 10% r.h. and 90°F. conditions require 1.5 days; 90% r.h. and 90°F conditions, 10.5 days; 30% r.h. and 60°F conditions, 5.3 days. See texture finish application found later in this chapter for specific drying times.

framing installation

General Requirements

The choice and installation of framing depends on a number of factors. In the case of wood framing these include the species, size and grade of lumber used. In the case of steel framing, the configuration of the frame member, size, and the thickness and grade of steel must be considered. Equally important are frame spacing and the maximum span of the surfacing material.

Loads—Framing members and their installation must be selected according to their ability to withstand the loads to which they will be subjected. These include live loads (contributed by the occupancy and elements such as wind, snow and earthquake) and dead loads (weight of the structure itself).

Deflection—Even though an assembly is structurally capable of withstanding a given load, its use may be restricted because the amount of deflection that occurs when the load is applied exceeds that which the surfacing materials can sustain without damage. Obviously, this deflection factor influences the selection of surfacing materials.

For drywall assemblies it is desirable to limit deflection to L/240[1] and to never exceed L/120. The preferred limit for veneer assemblies is L/360 and should not exceed L/240.

[1] Using L/240 as an example, and where the length of a span (distance between framing members) is 24″, deflection is figured as follows:

$$D = \text{Deflection Limit} = \frac{L}{240}$$

$$D = \frac{24''}{240}$$

$$D = 0.1 \text{ in.}$$

Frame Spacing—A factor in load-carrying capability and deflection; also it can be a limiting factor for the finishing materials.

Every finishing or surfacing material is subject to a span limitation—the maximum distance between frame members that a material can span without undue sagging. For that reason, "maximum frame spacing" tables for the various board products are included in this chapter. However, where frame spacing exceeds maximum limits, furring members can be installed to provide necessary support for the surfacing material (covered in this chapter under Wall and Ceiling Furring).

Insulation and Services—Plumbing, electrical and other fixtures, and mechanicals within the framing cavities must be flush with or inside the plane of the framing. Fasteners used to assemble the framing must be driven reasonably flush with the surfaces. In wood frame construction, the flanges of batt-type insulation must be attached to the sides of frame members and *not* to their faces. Any obstruction on the face of frame members that will prevent firm contact between the gypsum board and framing can result in loose or damaged board and fastener imperfections.

Wood Framing

Wood framing meeting the following minimum requirements is necessary for proper performance of all gypsum board assemblies:

1. Framework should meet the minimum requirements of HUD/FHA, American Softwood Lumber Standard and local building codes.

2. Framing members should be straight, true and of uniform dimension. Studs and joists must be in true alignment; bridging, fire stops, soil pipes, etc., must not protrude beyond framing.

3. All framing lumber should be the correct grade for the intended use, and 2″×4″ nominal size or larger should bear the grade mark of a recognized inspection agency.

4. All framing lumber should have a moisture content not in excess of 15% at time of gypsum board application.

5. Do not attach gypsum boards to extremely soft or undersize framing members.

Failure to observe these minimum framing requirements, which are applicable to screw, nail and adhesive attachment, will materially increase the possibility of fastener failure and surface distortion due to warping or dimensional changes. This is particularly true if the framing lumber has greater than normal tendencies to warp or shrink after erection.

The moisture content of wood framing should be allowed to adjust as closely as possible to the level it will reach in service before board application begins. After the building is enclosed, delay board application as long as possible (consistent with schedule requirements) to allow this moisture content adjustment to take place.

Provide heat at a constant temperature within the range of 55° to

70°F. (13° to 21°C) during winter or cold, damp weather. Provide ventilation to remove excess moisture.

Framing should be designed to accommodate for shrinkage in wide dimensional lumber such as is used for floor joists or headers. Gypsum board surfaces can buckle or crack if firmly anchored across the flat grain of these wide wood members as shrinkage occurs. With high uninterrupted walls such as are a part of cathedral ceiling designs or in two-story stairwells, regular or modified balloon framing can minimize the problem.

Framing Corrections—If joists are out of alignment, 2″×6″ leveling plates attached perpendicular to and across top of ceiling joists may be used. Toe-nailing into joists pulls framing into true horizontal alignment and insures a smooth, level ceiling surface. Bowed or warped studs may be straightened by sawing the hollow sides at the middle of the bow and driving a wedge into the saw kerf until the stud is in line. Reinforcement of the stud is accomplished by securely nailing 1″×4″ wood strips or "scabs" on each side of the cut (see photo).

Nailing of "scab" to straighten warped wood stud

installation

For wood framing installed in the conventional manner with lumber meeting requirements outlined above, maximum frame spacing is as listed on following pages:

Frame Spacing—Veneer Construction
Direct Application

board thickness	construction	location	application method[1]	max. frame spacing o.c.	
				in	mm
½" (12.7 mm)	one layer, 1-coat finish	ceilings	perpendicular	16	406
		sidewalls	perpendicular or parallel	16	406
	one layer, 2-coat finish	ceilings	perpendicular	16 or 24[2]	406 or 610[2]
		sidewalls	perpendicular or parallel	16 or 24[2]	406 or 610[2]
	two layer, 1- & 2-coat finish	ceilings	perpendicular	24	610
		sidewalls	perpendicular or parallel	24	610
⅝" (15.9 mm)	one layer, 1-coat finish	ceilings	perpendicular	16 or 24[2]	406 or 610[2]
		sidewalls	perpendicular or parallel	16 or 24[2]	406 or 610[2]
	one layer, 2-coat finish	ceilings	perpendicular	24[2]	610[2]
		sidewalls	perpendicular or parallel	24[2]	610[2]
	two layer, 1- & 2-coat finish	ceilings	perpendicular	24	610
		sidewalls	perpendicular or parallel	24	610

(1) Perpendicular preferred on all applications for maximum strength. Where fire rating is involved, application must be identical to that in assembly tested. Parallel application not recommended for ceilings.
(2) 24" o.c. frame spacing with either one- or two-coat veneer application requires PERF-A-TAPE Reinforcement and DURABOND Joint Compound.
The same limitations for overlaid unsupported insulation apply as for drywall construction; see "Frame Spacing—Drywall Construction."

Frame Spacing—Drywall Construction

Direct Application

board thickness	location	application method[1]	max. frame spacing o.c. in	max. frame spacing o.c. mm
SINGLE-LAYER APPLICATION			in	mm
⅜″ (9.5 mm)	ceilings[2][3]	perpendicular[3]	16	406
	sidewalls	parallel or perpendicular	16	406
½″ (12.7 mm)	ceilings	parallel[3]	16	406
		perpendicular	24[4]	610
	sidewalls	parallel or perpendicular	24	610
⅝″ (15.9 mm)	ceilings	parallel[3]	16	406
		perpendicular	24	610
	sidewalls	parallel or perpendicular	24	610
DOUBLE-LAYER APPLICATION				
⅜″ (9.5 mm)	ceilings[5]	perpendicular	16	406
	sidewalls	perpendicular or parallel	24[6]	610
½″ & ⅝″ (12.7 & 15.9 mm)	ceilings	perpendicular or parallel	24[6]	610
	sidewalls	perpendicular	24[6]	610

(1) Long edge position relative to framing. (2) Not recommended below unheated spaces. (3) Not recommended if water-based texturing material is to be applied. (4) Max. spacing 16″ if water-based texturing material to be applied. (5) Adhesive must be used to laminate ⅜″ board for double-layer ceiling construction. (6) Max. spacing 16″ o.c. if fire rating required.

Ceiling Insulation—To prevent objectionable sag in ceilings, weight of overlaid unsupported insulation should not exceed 1.3 psf for ½″ thick panels with frame spacing 24″ o.c.; 2.2 psf for ½″ panels on 16″ o.c. framing and ⅝″ panels 24″ o.c.; ⅜″ thick panels must not be overlaid with unsupported insulation. A vapor retarder should be installed in all exterior ceilings, and the plenum or attic space properly vented. In winter or cold climates, a polyethylene vapor retarder should not be used unless the insulation is installed prior to ceiling panels.

Resilient Application—On ceilings of both drywall and veneer assemblies, install RC-1 Channels 24″ o.c. for joists 16″ o.c.; 16″ o.c. for joists 24″ o.c. For sidewalls, install at 24″ o.c. See single-layer sections in tables, preceding pages, for limitations for specific board thickness.

Cable Heat Ceilings—Maximum frame spacing is 16″ o.c. for ½″ USG R. H. Base; 24″ o.c. for ⅝″ base.

Spray-Textured Ceilings—Where water-based texturing materials are used over single-layer panels, max. frame spacing is 16″ o.c. for ½″ panels applied perpendicular to framing. Parallel application is not recommended, nor is use of ⅜″ thick panels.

Water based texturing materials applied to ceilings should be completely dry before insulation and vapor retarder are installed. Under most conditions, drying takes several days; i.e., 10% r.h. and 90°F. conditions require 1.5 days; 90% r.h. and 90°F conditions, 10.5 days; 30% r.h. and 60°F. conditions, 5.3

days. See texture finish application on pages following this chapter for specific drying times.

partition layout

Properly position partitions according to layout. Snap chalk lines at ceiling and floor. Be certain that partitions will be plumb. Where partitions occur parallel to and between joists, ladder blocking must be installed between ceiling joists.

Steel Framing

Steel stud framing for non-load bearing interior partitions is secured to floors and ceilings with runners fastened to the supporting structure.

runner installation

Securely attach runners:

1. To concrete and masonry—use stub nails, power-driven fasteners, or the TAPCON® Concrete Fastening System.

2. To metal concrete inserts—use ⅜″ Type S-12 Pan Head Screws.

3. To suspended ceilings—use expandable molly type fasteners or toggle bolts.

4. To wood framing—use 1¼″ Type S Oval Head Screws or 12d nails.

To all substrates, secure runners with fasteners located 2″ from each end and spaced max. 24″ o.c. Attach runner ends at door frames with two anchors when 3-piece frames are used. (One-piece frames should be supplied with welded-in-place floor anchor plates, pre-punched for two anchors.)

At partition corners, extend one runner to end of corner and butt other runner to it, allowing necessary clearance for gypsum board thickness. Runners should not be mitered.

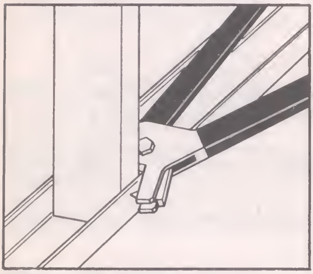
Fastening channel runners

Fastening angles

stud erection

Insert floor-to-ceiling USG Steel Studs between runners, twisting them into position. Anchor all studs adjacent to door and borrowed light frames, partition intersections and corners to floor and ceiling runners. For ST and CWS styles, use the USG Metal Lock Fastener (or equivalent) or positive screw attachment with USG ⅜″ or ½″ Type S or S-12 Pan Head Screws through each stud flange and runner flange.

Place studs in direct contact with all door frame jambs, abutting partitions, partition corners and existing construction elements. Fasten these studs to floor and ceiling runners using positive screw attachment or a USG Metal Lock Fastener (see below). Grouting of door frames is always recommended and is required where heavy or oversize doors are used. (See Special Applications section for grouting information.)



USG Metal Lock Fastener . . .

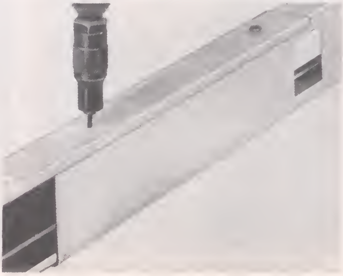
Pierces and folds light metal

Where a stud directly abuts an exterior wall and there is a possibility of condensation or water penetration through the wall, place a No. 15 asphalt felt strip between stud and wall surface.

Over metal doors and borrowed light frames, place a section of runner horizontally with a web-flange bent at each end. Fasten with one positive attachment per flange. At the location of vertical joints over the door frame header, position a cut-to-length stud extending to the ceiling runner. (See section, Framing Door and Window Openings.)

USG Steel Studs may be conveniently spliced together when required. To splice two studs, nest one into the other forming a box section, to a depth of at least 8″.

Fasten together with two ⅜″ Type S Pan Head Screws in each flange. Locate each screw (shown at right) no more than 1″ from ends of splice.



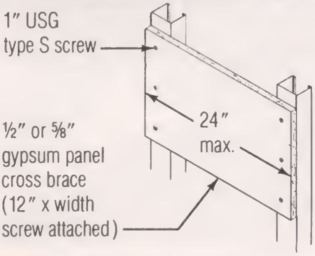
Steel studs are positioned in floor and ceiling runners

chase wall framing

Align two parallel rows of floor and ceiling runners according to partition layout. Spacing between outside flanges of each pair of runners must not exceed 24″. Follow instructions above for attaching runners.

Position steel studs vertically in runners, with flanges in the same direction, and with studs on opposite sides of chase directly across from each other. Except in fire-rated walls, anchor all studs to floor and ceiling runner flanges with USG Metal Lock Fastener or ⅜″ or ½″ Type S Pan Head Screws.

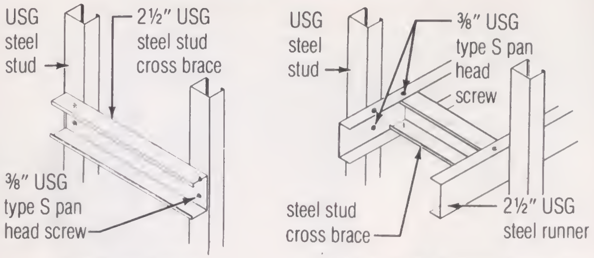
Methods of cross-bracing



gypsum brace

Cut cross-bracing to be placed between rows of studs from gypsum board 12″ high by chase wall width. Space braces 48″ o.c. vertically and attach to stud web with six 1″ Type S Screws per brace. If larger braces are used, space screws 8″ o.c. max. on each side.

Methods of cross-bracing

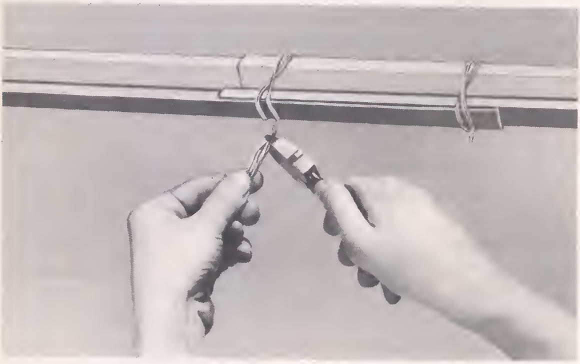


steel stud brace **steel stud & runner brace**

Bracing of 2½″ min. steel studs may be used in place of gypsum board. Anchor web at each end of metal brace to stud web with two ⅜″ Pan Head Screws. When chase wall studs are not opposite, install steel stud cross-braces 24″ o.c. horizontally, and securely anchor each end to a continuous horizontal 2½″ runner screw-attached to chase wall studs within the cavity.

Furred Ceiling Framing

Space USG Metal Furring Channels 24″ o.c. at right angles to bar joists or other structural members spaced 48″ o.c. max. Saddle-tie furring channels to bar joists with double-strand 18-ga. tie wire at each intersection. Provide 1″ clearance between furring ends and abutting walls and partitions. At splices, nest furring channels with at least 8″ overlap and securely wire-tie each end with double-strand 18-ga. tie wire (see illustration). Frame around openings such as light troffers with additional furring channels and wire-tie to bar joists.



Max. allowable spacing for USG Metal Furring Channel is 24″ o.c. (for ½″ and ⅝″ thick gypsum panels); max. span is 48″. See frame spacing tables for spans for veneer base applications.

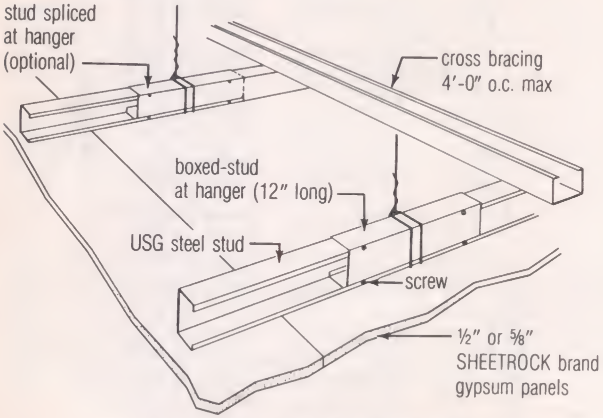
For bar joist spacing greater than 48″ and up to 60″, use USG Steel Studs as furring channels. Wire-tie studs to supporting

Limiting Span—USG Steel Stud Ceiling System(1)

stud style		212ST			358ST*			400ST*			212CWS			358CWS			400CWS			600CWS		
stud spacing-in.		12	16	24	12	16	24	12	16	24	12	16	24	12	16	24	12	16	24	12	16	24
single span																						
uniform load —psf	5	11′0″	10′0″	8′9″	14′9″	13′3″	11′0″	16′0″	14′6″	12′3″	13′6″	12′3″	10′9″	18′0″	16′3″	14′3″	19′6″	17′6″	15′6″	26′9″	24′3″	21′3″
	10	8′9″	8′0″	6′3″	11′0″	8′3″	5′6″	12′3″	10′9″	8′9″	10′9″	9′9″	8′6″	14′3″	13′0″	11′3″	15′6″	14′0″	12′3″	21′3″	19′3″	16′9″
	15	7′9″	6′3″	4′3″	7′6″	5′6″	—	10′0″	8′9″	7′0″	9′3″	8′6″	7′6″	12′6″	11′3″	9′9″	13′6″	12′3″	10′3″	18′6″	16′9″	13′3″
	20	6′3″	4′9″	—	5′6″	4′3″	—	8′9″	7′6″	6′3″	8′6″	7′9″	6′6″	11′3″	10′3″	8′3″	12′3″	11′0″	9′0″	16′9″	14′6″	9′9″
double and triple span																						
uniform load —psf	5	12′0″	10′6″	8′0″	14′3″	11′9″	8′9″	17′3″	14′9″	12′0″	14′9″	13′6″	11′9″	19′9″	17′9″	15′6″	21′3″	19′3″	16′9″	29′6″	26′9″	22′0″
	10	8′0″	6′6″	5′0″	8′9″	7′0″	5′3″	12′0″	10′3″	8′3″	11′9″	10′9″	9′3″	15′6″	14′3″	11′9″	16′9″	15′3″	12′0″	23′0″	18′3″	14′0″
	15	6′0″	5′0″	—	6′6″	5′3″	—	9′9″	8′3″	6′9″	10′3″	9′3″	7′6″	13′6″	11′9″	9′9″	14′3″	12′0″	9′3″	17′0″	14′0″	10′6″
	20	5′0″	4′0″	—	5′3″	4′0″	—	8′0″	7′3″	5′9″	9′3″	8′0″	6′6″	11′6″	10′3″	8′3″	12′0″	10′0″	7′6″	14′0″	11′6″	8′6″

(1) Based on L/240 allowable deflection. Maximum spacing for cross bracing: 48″ o.c. *Stud end stiffening required.

framing as shown. Position 1⅝″ studs with open side up; position larger studs with opening to side. See preceding table for stud spacings and limiting spans.

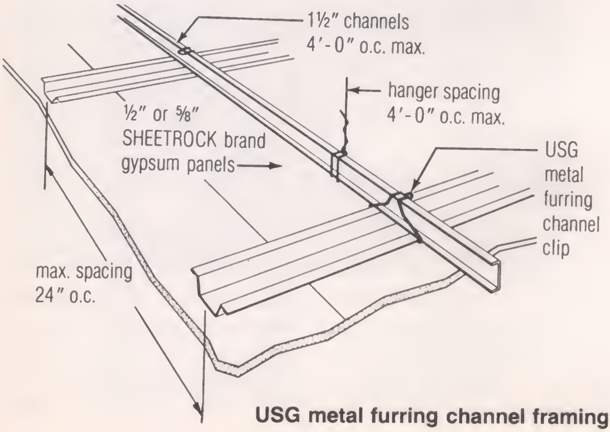


USG steel stud ceiling framing

suspended ceiling grillage erection

Space 8-ga. hanger wires 48″ o.c. along carrying channels and within 6″ of ends of carrying-channel runs. In concrete, anchor hangers by attachment to reinforcing steel, by loops embedded at least 2″ or by approved inserts. For steel construction, wrap hanger around or through beams or joists.

Install 1½″ carrying channels 48″ o.c. (24″ for fire-rated construction) and within 6″ of walls. Position channels for proper ceiling height, level, and secure with hanger wire saddle-tied along channels (see illustration). Provide 1″ clearance between runners and abutting walls and partitions. At channel splices,



USG metal furring channel framing

interlock flanges, overlap ends 12″ and secure each end with double-strand 18-ga. tie wire.

Erect metal furring channels at right angles to 1½″ carrying channels. Space furring within 6″ of walls. Provide 1″ clearance between furring ends and abutting walls and partitions. Attach furring channels to 1½″ channels with USG Furring Channel Clips installed on alternate sides of carrying channel. Saddle-tie furring to channels with double-strand 18-ga. tie wire when clips cannot be alternated. At splices, nest furring channels with at least 8″ overlap and securely wire-tie each end with double-strand 18-ga. tie wire.

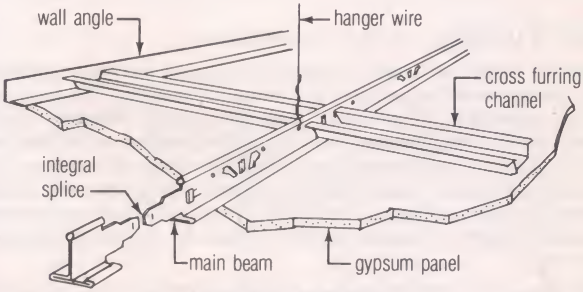
At light troffers or any openings that interrupt the carrying or furring channels, install additional cross-reinforcing to restore the lateral stability of grillage.

direct suspension system erection

Attach wall angles at ceiling height. Space 12-ga. hanger wires 48″ o.c. along main beams, within 6″ of beam ends and walls not having wall angles. Install main beams 48″ o.c. within 6″ of walls. Align main beam slots for cross furring channel and splice ends to insure continuity in each row.

Space cross furring channels 24″ o.c. within 6″ of walls without wall angles, at panel end joints and 8″ from gypsum panel end joints. Snap-lock ends to main beam and secure ends to wall angles with positive attachment.

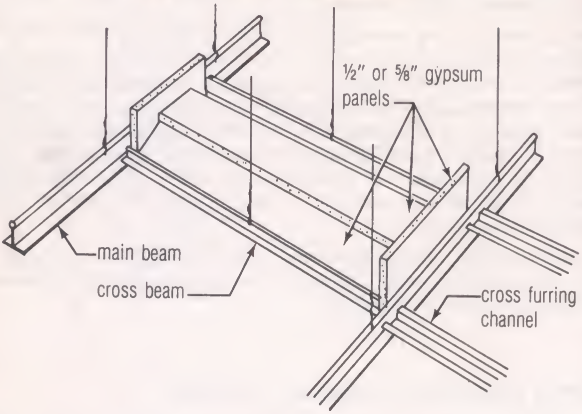
At light fixtures, place hangers at each corner and at mid span of cross beams. Install two cross beams to support lighting fixture and additional cross furring channels 8″ from each side of fixture.

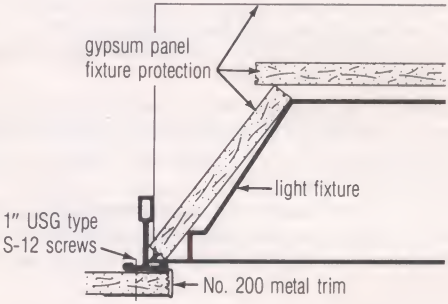


typical installation

Light Fixture Protection—Use over recessed lighting fixtures installed in USG Direct Suspension Grid when required in fire-rated construction. Cut pieces of ½″ or ⅝″ SHEETROCK Brand FIRECODE "C" Panels to form a five-sided enclosure, trapezoidal in cross-section (see detail). Fabricate box larger than the fixture to provide at least ½″ clearance between the box and the fixture.

light fixture fire protection





Wall Furring

Exterior walls are readily furred using ½" foil-back gypsum boards screw-attached to steel or wood framing. The foil-back board provides an effective, low-cost vapor retarder which meets ASTM requirements for vapor permeance not exceeding 0.06 perms. In these systems, different framing methods may be used to provide a vapor retarder, thermal insulation, and chase space for pipes, conduits and ducts. Vinyl wall coverings are not recommended in furred walls containing foil-back gypsum boards.

USG Metal Furring Channels are fastened directly to interiors of exterior walls or monolithic concrete and virtually any type of masonry—brick, concrete block, tile. With foil-back gypsum boards screw-attached to channels, this economical system provides an excellent vapor retarder and a durable, easily decorated interior surface.

USG Z-Furring Channels are used to mechanically attach THERMAFIBER Z-Furring Blankets or rigid plastic foam insulation to interiors of exterior walls. The insulation panels are applied progressively as Z-Furring channels are attached to the wall.

Gypsum boards are screw-attached to channel flanges to provide an interior surface isolated to a great degree from the masonry wall. In new construction and remodeling, this system provides a highly insulative self-furring solid backup for gypsum boards.

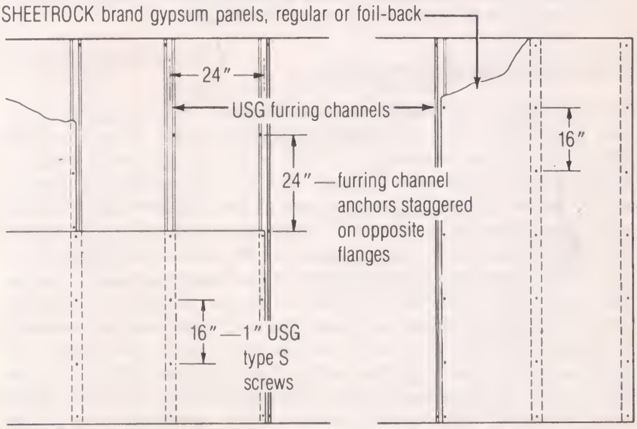
USG Steel Studs erected vertically between floor and ceiling runners serve as free-standing furring for foil-back gypsum boards screw-attached one side of studs. This free-standing system with 1⅝″ studs provides maximum clear chase space and minimizes possibilities for photographing or shadowing to occur. When greater heights are required, the stud framing is secured to the exterior wall with adjustable wall furring brackets at mid-height. Other furring providing greater height may be constructed with wider and heavier steel studs.

Temperature differentials on the interior surface of exterior walls may result in collection of dust on the colder surface areas. Consequently, shadowing (accumulated dust) may occur at locations of fasteners or furring channels where surface temperatures usually are lowest. United States Gypsum cannot be held responsible for surface discoloration of this nature. Where temperature, humidity and soiling conditions are expected to cause objectionable blemishes, use free-standing furring with insulation against the exterior wall.

furring channel erection—direct attachment

Attach metal furring channels to masonry or concrete surfaces, either vertically (preferred) or horizontally (for spacing, see frame spacing tables). For channels positioned horizontally, attach a furring channel not more than 4″ from both the floor line and the ceiling line. Secure channels with fasteners placed on alternate channel flanges and spaced 24″ o.c. Use a 2″ cut nail in mortar joints of brick, clay tile or concrete block or in the field of lightweight aggregate block; ⅝″ concrete stub nail, TAPCON

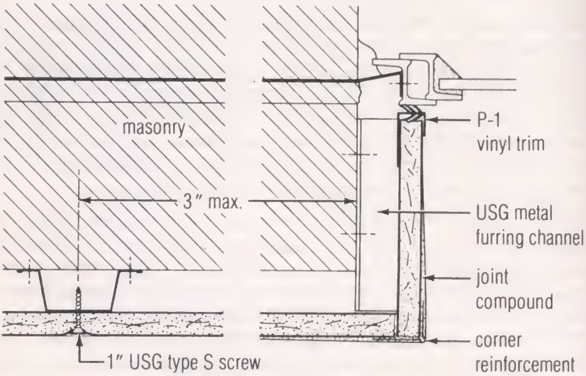
Wall elevation—furring



Perpendicular application **Parallel application**

Anchors or other power-driven fasteners in monolithic concrete.

At window locations, attach furring channels horizontally over masonry returns to support gypsum board at corners (see detail).



metal window—jamb

free-standing furring

Free-standing furring consists of 1⅝″ USG Steel Studs in 1⅝″ USG Steel Runners. To erect, plumb and align runners at the desired distance away from the exterior wall. Fasten runners to floor and ceiling with suitable anchors. Snap studs into place in runners (see framing spacing tables for required stud spacing).

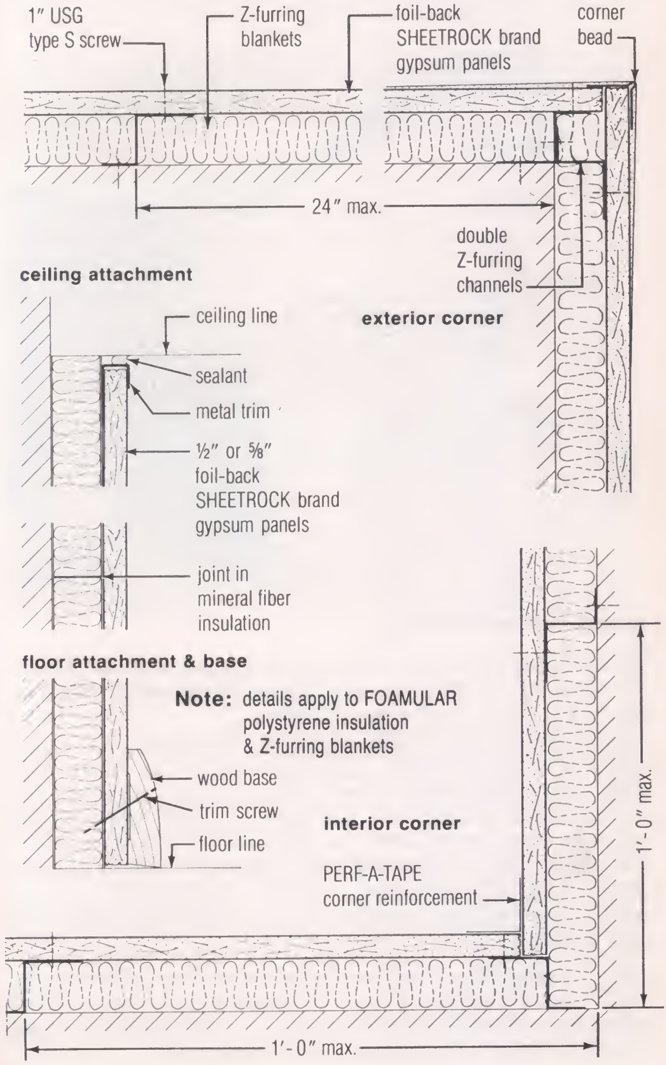
If greater height is required than can be attained with 1⅝″ studs, wider or heavier gauge studs can be used. However, if space is critical, extra height can be attained with 1⅝″ studs by bracing them to the exterior wall at mid-height. For bracing, install USG Adjustable Furring Brackets to the exterior wall and attach to the stud webs with ⅜″ Pan Head Type S Screws.

Z-furring channel erection

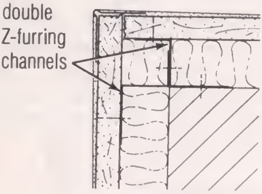
Erect insulation vertically and hold in place with Z-furring channels spaced 24″ o.c. Except at exterior corners, attach narrow flanges of furring channels to wall with concrete stub nails or power-driven fasteners spaced 24″ o.c. At exterior corners, attach wide flange of furring channel to wall with short flange extending beyond corner. On adjacent wall surface, screw attach short flange of furring channel to web of attached channel. Start from this furring channel with a standard width insulation panel and continue in regular manner. At interior corners, space second channel no more than 12″ from corner and cut insulation to fit. Hold mineral-fiber insulation in place until gypsum boards are installed with 10″ long staple field-fabricated from 18-ga. tie wire and inserted through slot in channel. Apply wood blocking around window and door openings and as required for attachment and support of fixtures and furnishings.

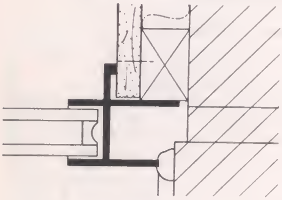
Apply gypsum boards parallel to channels with vertical joints occurring over channels. Use no end joints in single-layer application. Attach gypsum boards with 1″ Type S Screws spaced 16″ o.c. in field of boards and at edges, and with 1¼″ Type S Screws spaced 12″ o.c. at exterior corners. For double-layer application, apply base layer parallel to channels, face layer either perpendicular or parallel to channels with vertical joints offset at least one channel. Attach base layer with screws 24″ o.c. and face layer with 1⅝″ screws 16″ o.c.

Z-furring application details

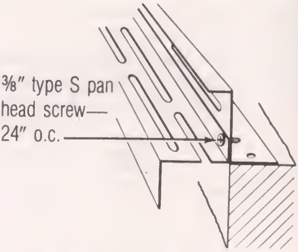


Z-furring application details



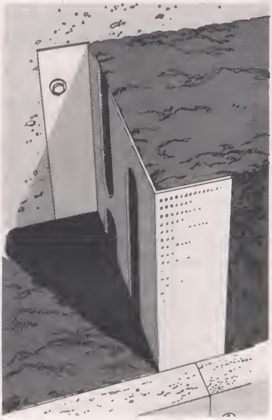


jamb



exterior corner framing

Design of USG Z-Furring Channel helps prevent wicking of moisture to inside surfaces, avoids faults of metal-over-insulation systems where "fishhooking" of pins can occur. Channel is available in four depths, 1″ to 3″.



wood furring erection

Wood furring strips over wood framing must be 2″×2″ (nom.) min. size for nail-on application. Strips may be 1″×4″ (nom.) if gypsum board is to be screw-attached.

When board is to be applied parallel to furring strips securely attached to masonry walls, use strips 2″×3″ or 1″×3″ (nom.) min. size; where long edges of board are to be applied across the furring, use strips 2″×2″ or 1″×2″ (nom.) min. size. Space furring strips as specified by frame spacing tables. For board application select a screw length that will not penetrate through furring.

Where there is a possibility of water penetration through the walls, install a layer of asphalt felt between furring strips and wall surface.

Note: Application of gypsum board over 1″×1″ (nom.) wood furring applied across framing members is not recommended since the relative flexibility of undersize furring prevents proper fastening and tends to loosen nails already driven.

Resilient Framing—Wood Frame

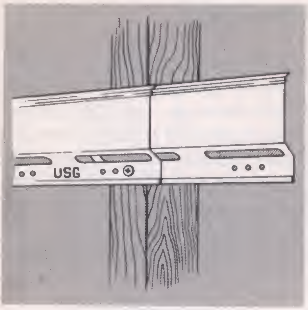
Resilient attachment of gypsum board (below) with RC-1 Resilient Channels provides low-cost, highly efficient, sound-rated drywall and veneer partitions and floor-ceilings. The steel channels "float" the boards away from the studs and joists; provide a spring action that isolates the gypsum board from the framing. This spring action also tends to level the board surface when installed over uneven framing. Additional features include excellent fire resistance (from the total assembly) and simple, fast installation for overall economy. For fire and sound-resistant assemblies, refer to U.S.G. Construction Selector, SA-100.

resilient channels—partitions

Attach RC-1 Resilient Channels at right angles (perpendicular) to wood studs. Position channels with attachment flanges down. Use 1¼″ USG Type W Screws or 6d coated nails with ¼″ flat heads driven through the flanges for attachment. Fasten channels to studs at each intersection.

Locate channels 2″ max. up from floor, within 6″ of the ceiling and at no more than 24″ intervals. (For some veneer assemblies max. channel spacing is 16″ o.c.—refer to frame spacing tables earlier in this chapter.) Extend channels into all corners and attach to corner framing. Splice channels directly over studs by nesting (*not* butting) the channels and driving fastener through both flanges into the support.

Where cabinets are to be installed, attach RC-1 Channels to studs directly behind cabinet hanger brackets. When distance



RC-1 channel splice

Channel attachment to stud

between hangers exceeds 24″ o.c., install additional channel at midpoint between hangers.

For cabinet installation with resilient framing, refer to section on "Special Applications and Constructions."

resilient channels—ceilings

Attach RC-1 Resilient Channels at right angles to wood joists. Use 1¼″ Type W, 1¼″ or 1″ Type S Screws driven through channel attachment flange for single-layer construction. For fire-rated, double-layer assembly, apply RC-1 Channels over base layer and attach with 1⅞″ Type S Screws driven through channel flange and base layer into joist (see UL Des L511). Fasten channels to joists at each intersection. *Do not* use nails to attach channels to joists in either single- or double-layer assemblies.

methods for applying drywall and veneer bases

Gypsum panels and gypsum bases may be applied in one or two layers directly to wood framing members, to steel studs or channels, or to interior masonry walls with adhesive.

Single Layer vs. Double Layer

Single-Layer Application—This basic construction is used to surface interior walls and ceilings where economy, fast erection and fire resistance are required. It is equally suitable for remodeling, altering and resurfacing cracked and defaced areas.

Double-Layer Application—Consists of a face layer of gypsum board applied over a base layer of gypsum board that is directly attached to framing members. This construction can offer greater strength and higher resistance to fire and to sound transmission than single-layer applications. Double-layer construction when adhesively laminated is especially resistant to cracking and provides the finest, strongest wall available. Also, these

Nailing technique for single-layer board application

adhesively laminated constructions are highly resistant to sag and joint deformation. In double-layer application, *always* apply all base-layer board in each room before beginning face-layer application.

Attachment Methods

Gypsum boards are attached to framing by several methods depending on the type of framing and the results desired.

Single Nailing—Conventional attachment for wood framing.

Double Nailing—Minimizes defects due to loose board.

Adhesive Attachment—A continuous bead of drywall stud adhesive applied to wood framing plus supplement nailing improves bond strength and greatly reduces the number of face nails needed.

Screw Attachment—USG Screws are excellent insurance against fastener pops caused by loosely attached board. Screws are recommended for wood frame attachment, and required for attachment to steel framing.

Screw attachment along vertical edges of face-layer board in double-layer application

Adhesive Lamination (Double Layer)—Produces the finest interior surfaces. Adhesive attachment of face layer to base layer in double-layer construction and of single-layer board to interior masonry walls usually requires only supplemental mechanical fastening until adhesive attains full bond. Reduces nails or screws required, saves finishing labor and minimizes fastener pops and joint ridging. A DURABOND Joint Compound or USG Ready-Mixed Joint Compound-Taping or All Purpose is required for adhesive lamination with fire-rated assemblies.

Perpendicular vs. Parallel Application

Gypsum board may be applied perpendicular (long edges of board at right angles to the framing members) or parallel (long edges parallel to framing). Fire-rated partitions may *require* parallel application (see Chapter 3 for specific systems).

Perpendicular application generally is preferred because it offers the following advantages:

1. Reduces the lineal footage of joints to be treated up to 25%.

2. Strongest dimension of board runs across framing members.

3. Bridges irregularities in alignment and spacing of frame members.

4. Better bracing strength—each board ties more frame members together than does parallel application.

5. Horizontal joints on wall are at a convenient height for finishing.

Starting at ceiling line, horizontal board is screw-attached (left). Parallel application (right) is used in special situations.

For wall application, if ceiling height is 8′1″ or less, perpendicular application results in fewer joints, easier handling and less cutting. If ceiling height is greater than 8′1″ or wall is 4 ft. wide or less, parallel application is more practical. For ceiling applica-

tion, use whichever methods results in fewer joints, or is required by frame spacing limitations.

For double-layer ceiling application, apply base-layer boards perpendicular to frame members; apply face layer parallel to framing with joints offset. On wall, apply base layer parallel with long edges centered on framing; apply face layer perpendicular. *Exception;* when using TEXTONE Gypsum Panels for face layer, apply base-layer boards at right angles to studs.

drywall and veneer base application

General Recommendations for gypsum panels and gypsum bases applied to wood and steel framing:

1. Apply ceiling boards first.

2. Cut boards so that they slip easily into place.

3. Butt all joints loosely. *Never* force panels into position.

4. Place tapered or wrapped edges next to one another.

5. *Never* place a butt end or a cut edge next to a tapered or rounded edge. Wherever possible, apply boards perpendicular to framing and in lengths that will span ceilings and walls without creating end (butt) joints. If butt joints do occur, stagger and locate them as far from the center of walls and ceilings as possible.

6. Support all ends and edges of gypsum board on framing, except long edges at right angles to framing and where end joints are to be floated between frame members and back-blocked (Back-Blocking is covered later in this chapter).

7. If metal trim is to be installed around edges, doors, or windows, determine if trim is to be installed before panel application. Refer to Chapter 1 for description of products, and Chapter 2 for installation.

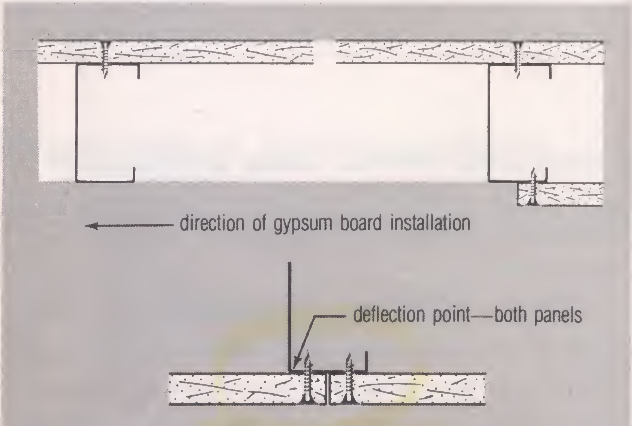
8. Do not anchor panel surfaces across the flat grain of wide dimensional lumber such as floor joists and headers. Float panels over these members or provide a control joint to compensate for wood shrinkage.

9. To insure level surfaces at joints, arrange board application so that the leading edge of each board is attached to the open or unsupported edge of a steel stud flange. To do this, all studs must be placed so that their flanges point in the same direction. Board application is then planned to advance in the direction opposite to flange direction. When this simple procedure is followed, attachment of each board holds the stud flange at the joint in a rigid position for attachment of the following board.

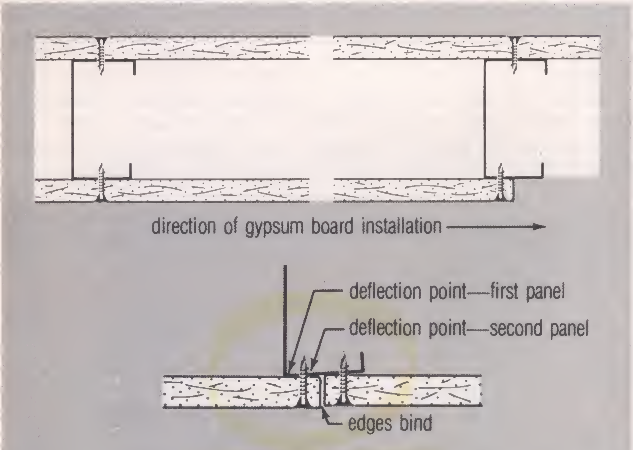
If the leading edge of gypsum board is attached to the web edge of a flange, the open edge of the flange can deflect under the pressure of attachment of the following gypsum board. Friction

between the tightly abutted board edges can then cause them to bind, preventing return of the second board to the surface plane of the first. A stepped or uneven joint surface results.

This recommended application procedure is absolutely essential for good results in steel-framed veneer and drywall assemblies. (See drawings following for correct methods.)



Correct application



Incorrect application

Measurements—All measurements must be accurate. Make two measurements as a check. This procedure will usually warn of partitions or door openings that are out of plumb or out of square. Then, framing corrections can be made before the board is hung. A 12- to 25-ft. steel power tape is recommended. Tools for measuring and cutting are shown in Chapter 8.

Cutting—Make straight-line cuts across full width or length of board by scoring the face paper, snapping the board core and then cutting the back paper. The common tool used to score and cut gypsum board is a utility knife with replaceable blade. Regardless of the type knife used, its blade should be kept sharp so that score will be made through paper without tearing or rolling it up, and into the gypsum core.

For cuts across the board width, a straightedge is recommended. An aluminum 4-ft. drywall T-square, ruled on both edges, facilitates clean, straight cuts. For cuts along the long length of the board, use a steel tape with an adjustable edge guide and a tip that accepts the utility knife blade. With this tape the edge guide is set for the desired width and placed against the board edge. The knife blade is then inserted into the slotted tape tip, and by moving both hands together the tool is drawn down the full length of the board to make a smooth and accurate cut.

Left to right, gypsum board is cut by scoring with utility knife against drywall T-square, then snapping toward back (top), cutting back paper with same knife and separating sections (below)—quick method to obtain clean edges and precise fit.

Cut edges of board are smoothed with a rasp, coarse sandpaper or piece of metal lath stapled around wood block (right). Measurements for cutouts are carefully made with flexible rule (below).

Cut and fit board neatly for pipes, electrical outlet boxes, medicine cabinets, etc. Holes for electrical outlet boxes can be made with a special outlet box cutting tool. For circular holes, an adjustable circular cutting tool is available. Keyhole saws can be used for any type of cutout. After cutting hole, remove any loose face paper at cut. (Refer to Chapter 8, Tools and Equipment, for examples of cutting tools.)

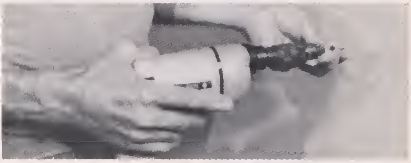
Adjustable cutting tool makes quick work of circular holes, as cutter wheel on calibrated shaft rotates from center pin (left). Edges are trimmed with hook-bill knife (right). Stiff drywall saw and other tools are used to make odd-shaped cuts.

Screw Application

USG Screws are applied with a positive-clutch electric power tool, commonly called an electric screwgun, equipped with adjustable screw-depth control head and a Phillips bit. The use of screws provides a positive mechanical attachment of gypsum board to either wood or steel framing.

Adjust Screwgun—Set adjustment for proper screw depth. For gypsum *panels* (drywall), screwhead must be driven slightly below face of panel, but not deep enough to break the paper. For gypsum *bases* (veneer), screwhead is set flush with the base surface. To adjust depth, rotate control head to provide proper screw depth. When proper adjustment has been made, secure control head to maintain adjustment (illustrated below).

Place Screw—Phillips head tip holds drywall screw for driving (below, center). Bit tip does not rotate until pressure is applied to gypsum board during application.



Start Screw Straight—Firm hand grip on electric screwgun is important for straight line of entry. To avoid stress on wrist, hold gun as shown (bottom, above), not by the pistol grip. Screw must enter perpendicular to board face for proper performance. Drive screws at least ⅜″ from ends or edges of board.

Operate electric screwgun constantly during usage. When screwhead is driven solidly against board, screwgun head will automatically stop turning as the positive clutch disengages.

The electric screwgun technique is relatively simple and a proficiency with the tool can be developed after a few hours' use. For description of USG Screws, see Chapter 1; for screw spacing, see pertinent U.S.G. systems, Chapter 3, and the Fastener Spacing Table later in this chapter.

Staple Application

Staples are recommended only for attaching base layer boards to wood framing in double layer assemblies. Staples should be 16-ga. flattened galvanized wire with 7⁄16″ wide crown divergent points and leg lengths to provide min. 5⁄8″ penetration into supports. Drive staples with crown perpendicular to gypsum board edges except where edges fall on supports. Drive staples so crown bears tightly against board but does not cut paper.

Single-Nailing Application

1. Drive nails at least 3⁄8″ from ends or edges of gypsum board.

2. Position nails on adjacent ends or edges opposite each other.

3. Begin nailing from *center* of board and proceed toward outer ends or edges.

4. When nailing, apply hand pressure on board adjacent to nail being driven to insure that board is in tight contact with framing member.

5. Drive nails with shank perpendicular to face of board.

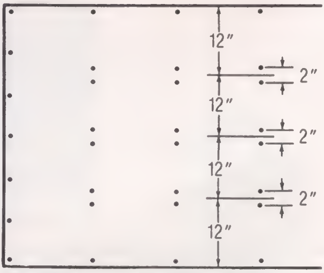
6. Use a drywall hammer with crowned head for gypsum *paneis.*

7. For gypsum *panels* (drywall), seat nail so head is in a shallow, uniform dimple formed by last blow of hammer.

8. Do not break paper or crush core at nailhead or around circumference of dimple by over-driving. Never use a nail set. Depth of dimple should not exceed 1⁄32″.

9. For veneer *base,* set nailheads flush with the base surface. *Do not* dimple.

Proper dimpling of nailhead



Double-nailing in field of board

Double-Nailing Application (Walls and Ceilings)

In the double-nailing method for attaching gypsum board to wood framing, space the first nails 12″ o.c. along the supports in

Max. Fastener Spacing—Gypsum Board Constructions[1]

framing	type const.	type fastener	location	max. fastener spacing			
				gypsum panels		gypsum base	
				in	mm	in	mm
wood	single layer[2]	nails	ceilings	7	178	7	178
			sidewalls	8	203	8	203
		screws	ceilings	12	305	12	305
			sidewalls	16	406	12	305
		screws—with RC-1 channels	ceilings	12	305	12	305
			sidewalls	12	305	12	305
	base layer of double layer—both layers mechanically attached	nails	ceilings	24	610	24	610
			sidewalls	24	610	24	610
		screws	ceilings	24	610	24	610
			sidewalls	24	610	24	610
		staples	ceilings	16	406	16	406
			sidewalls	16	406	16	406
	face layer of double layer—both layers mechanically attached	nails	ceilings	7	178	7	178
			sidewalls	8	203	8	203
		screws	ceilings	12	305	12	305
			sidewalls	16	406	12	305

(table continued on next page)

Max. Fastener Spacing—Gypsum Board Constructions[1] *continued*

framing	type const.	type fastener	location	max. fastener spacing: gypsum panels in	gypsum panels mm	gypsum base in	gypsum base mm
wood	base layer of double layer—face layer adhesively attached	nails	ceilings	7	178	7	178
			sidewalls	8	203	8	203
		screws	ceilings	12	305	12	305
			sidewalls	16	406	12	305
		staples	ceilings	7	178	7	178
			sidewalls	7	178	7	178
	face layer of double layer—face layer adhesively attached	nails	ceilings	16″ o.c. at ends and edges—1 field fastener per frame member at mid-width of board	406 mm o.c. at ends and edges—1 field fastener per frame member at mid-width of board	same as for gypsum panels	same as for gypsum panels
			sidewalls	fasten top and[3] bottom as required	fasten top and[3] bottom as required	same as[3] for gypsum panels	same as[3] for gypsum panels
steel	single layer	screws	ceilings	12	305	12	305
			sidewalls	16	406	12	305

base layer of double layer—both layers mechanically attached	screws	ceilings	16	406	16	406
		sidewalls	24	610	24	610
face layer of double layer—both layers mechanically attached	screws	ceilings	12	305	12	305
		sidewalls	16	406	12	305
base layer of double layer—face layer adhesively attached	screws	ceilings	12[4]	305[4]	12[4]	305[4]
		sidewalls	16[4]	406[4]	12[4]	305[4]
face layer of double layer—face layer adhesively attached	screws	ceilings	16" o.c. at ends and edges—1 field fastener per frame member at mid-width of board	406 mm o.c. at ends and edges—1 field fastener per frame member at mid-width of board	same as for gypsum panels	same as for gypsum panels
		sidewalls	fasten top and[3] bottom as required	fasten top and[3] bottom as required	same as[3] for gypsum panels	same as[3] for gypsum panels

[1] Fastener spacings based on wood framing 16" o.c., steel framing 24" o.c. Spacings are not for fire-rated assemblies; see test reports for fastener spacing for specific fire-rated assemblies. [2] See Adhesive Application covered later in this chapter for fastener spacing using adhesive. [3] When board has been prebowed. For flat boards, use temporary nails or Type G screws called for in Sheet or Strip Lamination section. [4] Spacing is 8" (203mm) o.c. at joint edges.

the field of the board and around the perimeter spaced 7″ o.c. for ceilings and 8″ o.c. for walls. Drive second nails about 2″ from first in field of board and make sure first nails are properly seated.

This application method helps prevent loose boards and resultant nail pops that may occur when boards are not applied correctly and drawn tightly to framing. This method will not reduce the incidence or severity of nail pops due to wood shrinkage.

Adhesive Application

In the adhesive method, a continuous bead of drywall stud or construction adhesive is applied to the face of wood framing. Adhesives should meet ASTM C557 standards. Gypsum boards are applied and attached with only a minimum number of supplementary fasteners compared to conventional fastening methods (see preceding table for fastener spacing required). When vinyl foam tape is used on sidewalls with drywall stud adhesive, supplementary fasteners are unnecessary.

Spacing of framing members is the same as that used for conventional attachment.

Advantages of attachment with adhesives are:

1. Reduces up to 75% of the number of fasteners used, and consequent problems.

2. Stronger than conventional nail application—up to 100% more tensile strength, up to 50% more shear strength.

3. Unaffected by moisture, high or low temperature; vermin-resistant.

4. Fewer loose panels caused by improper fastening.

5. Bridges minor framing irregularities.

6. Will not stain or bleed through most finishes.

Adhesives are commercially available and applied with bulk-loaded hand or powered adhesive gun or with 30-oz. cartridges. Contact adhesive manufacturer for information on his product and specification compliance.

general directions

The following recommendations will help explain the proper use of adhesives and the conditions which may affect the quality of the finished job.

1. Select the proper adhesive for specific job requirements. Read container directions carefully.

2. Make sure that all substrates are clean, sound and free from oil, dirt or contamination.

3. Exercise care regarding open flames when using flammable solvent adhesives in poorly ventilated areas.

4. Prevent freezing of adhesives, especially water-based adhesives.

5. Apply adhesives at temperatures between 50°F.(10°C) and 100°F.(38°C) except as directed by the manufacturer. Low temperatures may cause water-base products to ice the surface and result in poor bond. Extremely high temperatures may cause solvent-base products to evaporate rapidly, shortening open time and damaging bond characteristics.

6. Close containers whenever adhesive is not in use. Evaporation (or escape) of vehicle can affect adhesive's wetting and application properties.

7. *Do not* exceed open time specified by manufacturer. Disregarding of directions may cause poor bonding.

8. Follow manufacturer's recommendation on proper amounts of adhesive to be applied. Too small or too large a bead will lead to performance problems or waste.

9. Apply adhesive with proper tools and as recommended by the manufacturer.

cartridge preparation

Cut the cartridge tip in two different ways: for walls, make a chevron or "V" cut in order to produce a round, uniform bead. The cut edge of the nozzle then rides along the stud easily.

For ceilings, use a single, angled slash across the nozzle. This gives a wipe-on effect on the ceiling joist to minimize dripping.

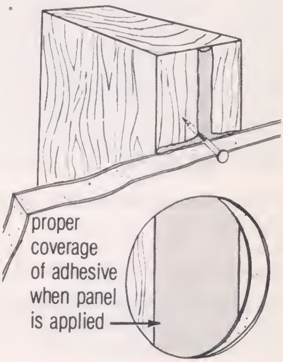
With a ⅜″ bead, approx. 3 to 5 gal. of adhesive will prepare framing for 1,000 sq. ft. of gypsum board. (See adhesive manufacturer for specific product coverage.)

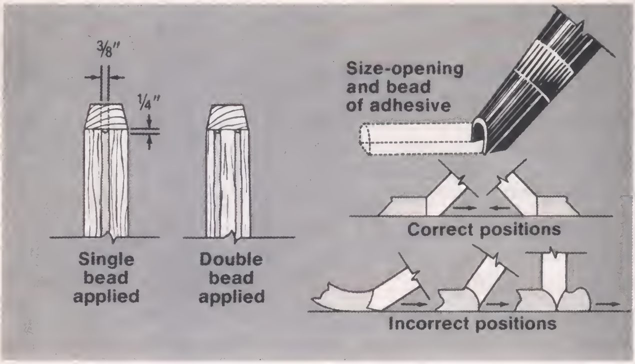
Proper nozzle opening and gun position (see page 114) are required to obtain the right size and shape of bead for satisfactory results. Initial height of bead over framing should be ⅜″ and of sufficient volume to provide 1⁄16″ thickness of adhesive over the entire support when compressed (drawing, below).

for walls **for ceilings**

Nozzle cuts

Apply adhesive in a continuous ⅜″ bead in center of attachment face (at right) and to within 6″ of ends of all framing members. Where two gypsum boards meet on a framing member, apply two continuous





3/8" beads to framing members at extreme edges of face, to insure adequate contact with paper on back of board. Do not apply adhesive to members such as bridging, diagonal bracing, etc. into which no supplemental fasteners will be driven. Adhesive is not required at inside corners, top and bottom plates, bracing or fire stops and is not ordinarily used in closets.

Place gypsum boards shortly after adhesive bead is applied and fasten immediately, using proper screws or nails. After board has been fastened, impact by hand along each stud or joist to insure good contact at all points.

Where fasteners at vertical joints are objectionable (such as with predecorated panels), boards may be prebowed and adhesively attached with fasteners at top and bottom only.

Prebow boards by stacking face up with ends resting on 2×4 lumber or other blocks and with center of boards resting on floor. Allow to remain overnight or until boards have a 2" permanent bow. (Under very humid conditions, board may be too flexible to assume stiff bow needed to provide adequate pressure against framing.)

To insure good bond, no more adhesive should be applied than can be covered within manufacturer's open-time limits. If adhesive is left exposed to the air for longer periods, the volatile materials will evaporate, causing surface hardness or skimming that prevents a full bond. Remove any excess adhesive from surface of board.

Allow adhesive to dry at least 48 hours before treating drywall joints or applying veneer finishes.

fastener spacing using adhesive

Ceilings—Perpendicular Application—Fasten at each framing intersection and 16" o.c. at each end. One temporary field fastener per framing member required at mid-width of board, depending on drying conditions.

Ceilings—Parallel Application—Space fasteners 16" o.c. along board edges and at each framing intersection on ends. Space temporary fasteners 24" o.c. on intermediate supports. If de-

sired, these temporary fasteners may be removed at the end of 48 hours, depending on drying conditions.

Walls—Perpendicular Application—Same as Ceilings—Perpendicular Application above, except that no field fasteners are required.

Walls—Parallel Application—Same as Ceilings—Parallel Application above, except that no fasteners are required on intermediate supports. Where fasteners at the vertical joints are objectionable, prebow the gypsum board and apply fasteners 16″ o.c. only at the top and bottom of the board.

Note: If using vinyl foam tape as a temporary supplementary fastener, follow manufacturer's directions for additional fasteners required.

Wood Frame—Single-Layer Application

This basic construction provides economical, quickly completed load-bearing walls and ceilings wherever fire protection is desired with wood framing—also usable for wall furring. All types of gypsum boards, including predecorated vinyl-faced panels, may be used in the assembly. For measuring and cutting, perpendicular or parallel application, framing requirements and fastening, refer to sections found earlier in this chapter. For complete information on fire- and sound-resistant assemblies, refer to U.S.G. Construction Selector, SA-100.

Nailing in ceiling starts from center toward edges.

installation

Wood Studs and Joists—Apply gypsum boards so that ends and edges occur over framing members, except when joints are at right angles to the framing members as in perpendicular application or when the end joints are to be back-blocked (see section following).

Fasteners are placed at least 3/8″ from edges and ends.

To minimize end joints, use boards of maximum practical lengths. When end joints occur, they should be staggered. Arrange joints on opposite sides of a partition so they occur on different studs.

Apply gypsum boards first to the ceiling and then to the walls. If foil-back gypsum boards are used, apply foil side against framing. Fit ends and edges closely but do not force boards into place. Cut boards accurately to fit around pipes and fixtures.

Usually two men are required to install long-length board on ceilings. Fasten boards with screws or nails *starting from the center* of boards and working toward the ends and edges. While fasteners are being driven, the boards must be held in firm contact with the framing or joists. When single fasteners are used, attach boards to framing with screws or nails spaced as shown in the Fastener Spacing Table. Drive fasteners at least 3/8″ from edges and ends of board.

Apply gypsum boards to the sidewalls after ceilings are erected. Where perpendicular application is used on walls, apply top wall board first, butted against ceiling. When parallel application is used, span sidewall from ceiling to floor with a single length of board. Use parallel application where ceiling height is over 8′1″ or where this method reduces waste and joint treatment.

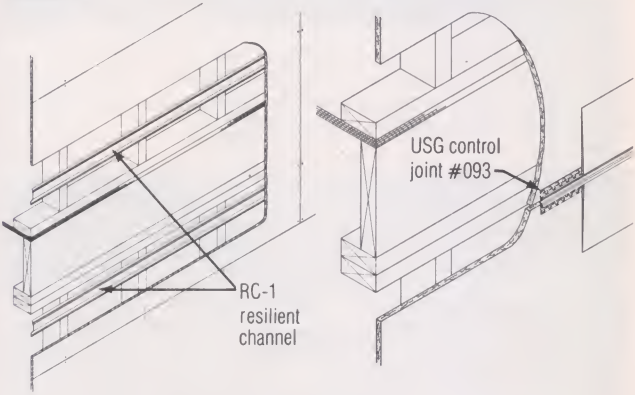
On sidewalls, space screws 16″ o.c. max. for gypsum panels, 12″ o.c. max. for gypsum base. Space nails 8″ o.c.

Wherever possible, use board of sufficient length to span wall areas. If joints occur near an opening, apply boards so vertical joints are centered, if possible, over opening. Keep vertical joints at least 8″ away from external corners of windows, doors, or similar openings except at interior or exterior angles within the room or when control joints are used.

After installation, exert hand pressure against wall and ceiling surfaces to detect loose fasteners. If loose fasteners are found, drive them tight. Whenever nails or screws have punctured paper, hold board tight against framing and install another fastener properly, about 1½″ from screw or nailhead which punctured paper. Remove the faulty fasteners. When nailing

boards to second side of a partition, check opposite side for nails loosened by pounding and drive them tight again.

With platform framing and sidewall expanses exceeding one floor in height, fur the gypsum boards over floor joists using RC-1 Resilient Channels (see detail below). As an alternate, install a horizontal control joint between gypsum boards at the junction of the bottom of top plates and the first-floor studs (see detail). Do not fasten gypsum boards to the side face of joists or headers.



Back-Blocking Application

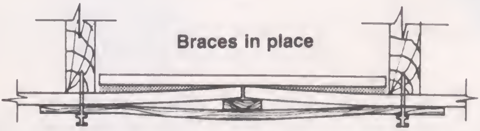
Back-Blocking is a system designed to minimize an inherent joint deformation ("ridging") in single-layer gypsum board construction, which sometimes occurs under a combination of adverse job and weather conditions. The Back-Blocking System, developed by United States Gypsum, has been widely used for years and produces outstanding results.

Back-Blocking consists of laminating cut-to-size pieces of gypsum board to the back surface of boards directly behind joints, providing resistance to ridging. Procedure follows:

a. Backing blocks, 8″ wide and long enough to fit loosely between framing, are spread with a DURABOND Joint Compound or USG Ready-Mixed Joint Compound-Taping or All Purpose. Apply adhesive in beads ½″ high, ⅜″ wide at the base spaced 1½″ o.c.

b. Apply gypsum boards horizontally with long edges at right angles to joists. Place backing blocks along full length of edge and ends of board. Floating of end joints makes it easier to form a good joint over a twisted stud or joist.

c. Immediately after all blocks are in place, erect the next board, which has been previously cut. Butt ends loosely. One man can complete fastening the board while another applies compound and places blocks along long edges of previously applied board.



d. Cross-section shows how floated end joint can be tapered with back-blocking. Brace is temporarily nailed over wood strip (see drawing) which depresses ends of panels. When strips are

removed, tapered formation remains as shown in above drawing. Tapering the butt end is recommended for drywall only; *not necessary* for veneer construction.

e. Sidewall blocks should be flush with or slightly behind the stud faces. To hold the blocks in place, install gypsum strips along the sides of the studs and set back from the stud faces enough to accommodate the block thickness.

f. After gypsum board is nailed in place, immediately butt adjacent board over backing block. Stagger end joints between upper and lower courses of board (shown above).

Back-blocking long edge joints on sidewalls is of less importance, but floating and back-blocking of all end joints on both sidewalls and ceilings are recommended. End joints on both sidewalls and ceilings may be tapered for *drywall* construction by the back-blocking method at the discretion of the owner, architect or applicator.

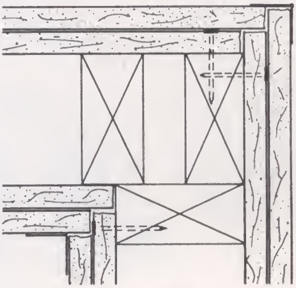
Double-Layer—Adhesive Lamination

In adhesive application, face-layer gypsum boards or predecorated TEXTONE Panels are job-laminated to a base layer of gypsum board or interior masonry partitions.

In multi-layer adhesive systems, the base layer must be attached with the same fastener, fastener spacing, and framing spacing as for a single-layer assembly of the same thickness as the base layer.

In fire-rated assemblies, permanent fasteners and the type of board used must be the same as in the particular tested assembly (see fire test report for complete description).

Application of the base layer may be either parallel or perpendicular to the framing. Plan the layout of the face layer so that all joints are offset a minimum of 10″ from parallel base-layer joints. It is preferable to apply the face layer perpendicular to the base layer. At inside vertical angles, only the overlapping base layer should be attached to the framing to provide a floating corner. Omit all face-layer fasteners within 8″ of vertical angles.



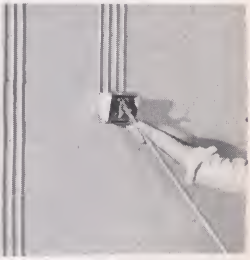
Corner detail

application—laminating adhesive

Apply commercially available laminating adhesive in strips to center and along both edges of face layer board. Apply strips with a notched metal spreader having four ¼″x¼″ minimum notches spaced max. of 2″ o.c. Position face layer against base layer; fasten at top and bottom (vertical application) as required. For laminated ceilings, space fasteners 16″ o.c. along edges and ends, with one permanent field fastener per framing member installed at mid-width of board. Press board into place with firm pressure to insure bond; reimpact within 24 hr. if necessary.

application—joint compound (used as laminating adhesive)

All DURABOND Joint Compounds and USG Ready-Mixed Joint Compounds—All Purpose and Taping may be used for two methods of lamination: sheet lamination and strip lamination.



In sheet lamination (above), notched spreader is used to spread compound over entire back surface of face-layer board. In strip lamination of vertical sidewall boards (right), adhesive can be applied to either base surface or face panel. Mechanical tool used is Ames Laminating Spreader.

When using DURABOND Compounds, supplemental or temporary fasteners or supports are required until compound has hardened (minimum three hours depending on which type of compound is used). Because the compound is of heavy consistency, it provides a leveling action not obtainable with thinner-bodied adhesives.

Mixing—DURABOND Compounds

1. Mix in a clean plastic container.

2. Use only clean, drinkable water.

3. Mix for approx. three minutes, making sure compound is uniformly damp. Let soak for 15 min., remix and apply.

4. Do not contaminate with previously mixed DURABOND, other compounds or dirty water as it will affect the hardening time.

5. Mix only as much compound as can be used within the time period indicated on the bag (usually one hour for DURABOND 90 and two hours for 210 for example.)

6. Do not add water to extend working time. DURABOND hardens regardless of whether water is added.

When using USG Ready-Mixed Joint Compounds for laminating, temporary nailing or permanent USG Type G Screws are needed until the compound is dry (usually overnight). In cold weather, provide heat to keep compound from freezing until adhesive is dry.

Mixing—USG Ready-Mixed Compounds
Use the compound at package consistency for best leveling action. If a thinner adhesive is desired, add cool water in half-pint increments to avoid overthinning. Remix lightly with a potato masher type mixer and test apply after each water addition. If compound becomes too thin, add thicker compound from the container and remix.

Application—Sheet Lamination—Precut and pre-fit face boards prior to compound application. Spread compound over entire back surface of face layer. Use a metal spreader-blade having ⅜″ wide × ½″ high min. size notches spaced 1½″ to 2″ o.c. An Ames laminating spreader may also be used. Caution must be taken with the Ames spreader to prevent hardening of compound in tool. Clean immediately after use.

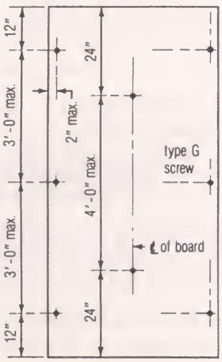
Immediately after compound is applied, position face layer and drive fasteners or install temporary bracing.

On all laminated ceilings, face layer must be permanently attached with fasteners spaced 16″ o.c. max. over entire surface at ends and edges, plus one field fastener in each frame member at mid-width of board. Nails must penetrate wood framing a minimum of ¾″. Screws must penetrate steel framing a minimum of ⅜″.

On walls, permanently attach top and bottom of the face layer with fasteners driven 24″ o.c. max. (except prebowed boards). Provide temporary support fasteners, or Type G Screws 24″ o.c. max. in the field of the board.

1. Temporary Nailing—Use double-headed scaffold nails driven through wood or gypsum board scraps so that nail penetrates framing a minimum of ¾″.

2. USG Type G Screws—Permanently attach face layer with screws driven into base layer to avoid framing. Apply compound just prior to face board erection to prevent wetting of base layer that would reduce holding power of screws. Press face layer firmly against base layer when driving screw. Compound should be thin enough to spread as screw is driven. Type G Screws should not be used with base-layer boards less than ½″ thick.



Strip Lamination (vertical face layer, sidewalls only)—This method is often preferred because it requires less compound and improves sound attenuation. Apply strips (four beads, each ⅜″ wide × ½″ high spaced 1½″ o.c.) 24″ o.c. max. Place permanent fasteners 24″ o.c. max. at each end of face

layer. Drive Type G Screws per diagram shown.

application—liquid contact adhesive

Apply liquid contact adhesive according to manufacturer's directions. Use a short nap paint roller to cover both contact surfaces. Let adhesive air dry to the touch. Apply boards as soon as possible after drying occurs. On walls, fasten 16″ o.c. at top and bottom (vertical application) as required. In ceiling lamination, apply permanent supplementary fasteners at each corner of board, and along edges spaced max. 48″ o.c. Press board into place with firm pressure to insure bond.

Wood Frame—Resilient Board Application

gypsum board—sidewalls

Apply gypsum boards perpendicular to wood framing with long dimension of boards parallel to resilient channels. Attach boards with 1″ USG Type S Screws spaced 12″ o.c. along channels. Center horizontal abutting edges of boards over screw flange of channel, and screw-attach. Where channel resiliency makes screw placement difficult, use the next longer screw. Take particular care that these longer screws do not penetrate the resilient channels and enter studs since this "grounding" will nullify the resilient properties of the channels. For fire-rated construction, float vertical butt joints between studs and back joint with a length of RC-1 Channel. Where fire rating is not required, board may be applied with long dimension vertical.

For two-layer application of gypsum board, apply base layer vertically and attach to resilient channels with 1″ Type S Screws spaced 24″ o.c. Apply face layer with long dimension at right angles to long edges of base layer and fasten with Type S Screws spaced 16″ o.c., and of sufficient length to penetrate channels ⅜″ min.

gypsum board—ceilings

Single Layer—Apply boards of maximum practical length with long dimension at right angles to resilient channels and end joints staggered. End joints may occur over resilient channels or midway between channels with joint floated and back-blocked with sections of RC-1 Channels (see UL Des L511). Fit ends and edges closely, but not forced together. Fasten boards to channels with 1″ Type S Screws spaced 12″ o.c. in field of boards and along abutting ends. Cut boards neatly and provide support around cutouts and openings.

Double Layer—Base—For fire-rated assembly (UL Des L511), apply gypsum base-layer boards with long edges across joists and end joints staggered. Fasten boards to framing with 8d cement-coated nails spaced 7″ o.c. Attach resilient channel through base layer perpendicular to framing with 1⅞″ Type S Screws.

Double Layer—Face—Apply boards in same manner as for single layer but at right angles to base layer. Fasten boards to resilient channels with 1″ Type S Screws spaced 12″ o.c.

Steel Frame—Single-Layer Application

This noncombustible assembly has won wide acceptance because of its sound attenuation, low cost, speed of erection and light weight—only 4 to 6 lb./ft.^{2} Partitions are ideal for corridors and space-division within units. Ceilings, both suspended and furred, conceal overhead structural and mechanical elements and provide a surface ready for either final decoration or adhesively applied acoustical tile.

With long edges of panels applied parallel to steel framing, workman places screws at 16″ intervals along stud.

gypsum board erection

Apply gypsum boards with long dimension parallel or perpendicular to framing. (See Frame Spacing Tables for limitations.) Use maximum practical lengths to minimize end joints. Position boards so all abutting ends and edges (except edges with perpendicular application) will be located in center of stud flanges. Plan direction of board installation so that lead edge or end of board is attached to open end of stud flange first. Be certain that joints are neatly fitted and staggered on opposite sides of the partition so they occur on different studs. Cut boards to fit neatly around all outlets and switch boxes.

For single-layer application, fasten boards to supports with 1″ USG Type S Screws spaced according to Fastener Spacing Table. Stagger screws on abutting edges or ends.

For fire-rated construction, apply gypsum boards and fasten as specified in the fire-tested assembly (see test report).

Steel Frame—Double-Layer Application

Double-layer construction using steel studs offers some of the best performances in both fire and sound resistance—up to 2-hr. fire ratings and 55 STC sound rating. These economical, lightweight partitions are adaptable as party walls or corridor walls in virtually every type of new construction.

In these assemblies a face layer of gypsum board is job-laminated to the base layer or screw-attached through the base-layer gypsum board to steel studs. The installation of USG Steel Studs and Runners is the same as for Single-Layer Application described earlier in this chapter.

base-layer erection

Apply gypsum board with long dimension parallel to studs. Position board so abutting edges will be located in center of stud flanges. Be certain joints are neatly fitted and staggered on opposite sides of partition so they occur on different studs. For double-layer screw attachment (both layers screw-attached), fasten panels to studs with USG Type S Screws spaced 24″ o.c. Use 1″ screws for ½″ and ⅝″ thick board. For double-layer adhesively laminated construction, fasten board with 1″ screws spaced 8″ o.c. at joint edges and 16″ o.c. in field for panels, 12″ o.c. for gypsum base. For fire-rated construction, fasten board as specified in the fire-tested design being erected (see test report).

face-layer erection

Apply gypsum board with long dimension parallel to studs. Position board so abutting edges will be located in center of stud flanges. Stagger joints from those in base layer and on opposite sides of partition. For double-layer screw attachment (both layers screw-attached), fasten face layer to studs with Type S Screws spaced 16″ o.c. for gypsum panels, 12″ o.c. for gypsum base. Use 1⁵⁄₁₆″ screws for ½″ thick board and 1⅝″ screws for ⅝″ thick board. (As a rule of thumb, screws should be a min. ⅜″ longer than the total thickness of material to be attached to steel studs.) For double-layer laminated construction, attach face layer using adhesive lamination described earlier in this chapter. For fire-rated construction, fasten gypsum boards with screws as specified in the fire-tested design (see test report).

Furred Framing—Board Application

Apply gypsum board of maximum practical length with long dimension at right angles to furring channel. Center end joints over channel web; fit joints neatly and accurately; stagger end joints from those in adjacent rows of board. Fasten boards to furring channels with Type S Screws spaced according to Fastener Spacing Table. Use 1″ screw length for ½″ or ⅝″ thick boards.

Masonry—Single-Layer Direct Application

Gypsum boards adhesively applied directly to interior, above-grade monolithic concrete or unit masonry provide durable noncombustible surfaces for these walls.

Gypsum boards are laminated using a DURABOND Joint Compound or USG Ready-Mixed Joint Compound-All Purpose or Taping; either regular or predecorated TEXTONE Panels may be applied. Use the Metal Furring Channels or Z-Furring Channels system described in this chapter for gypsum board application to interior of exterior and below-grade wall surfaces. The inside of exterior cavity walls having a continuous (1″ min.) clear air space between wythes, with the *outside surfaces of the interior masonry well dampproofed,* may be considered here as an interior wall surface.

preparation

Mortar joints on surface of unit masonry to which gypsum boards are to be bonded should be cut flush with the masonry to provide a level surface. The wall surface should be plumb and true. Grind off rough or protruding areas before lamination is started. Fill pockets or holes greater than 4″ in diameter and 1/8″ deep with grout, mortar, or DURABOND Joint Compound and allow to dry before laminating.

The masonry surface must have all form oils, grease and other release agents removed. It must be dry and free of dust, loose particles and efflorescence. If masonry has been coated or painted, test by attaching a small section of board to surface. Pull from surface after allowing sufficient time for adhesive to bond. If attachment fails at bond line to masonry, the surface coating must be removed or a furring system used.

If wood base is used, attach a wood nailer to the wall with mechanical fasteners before laminating gypsum boards. Nailer should be equal to the board thickness and at least 1 1/2″ high (or 3/4″ less than wood base height).

board erection with adhesive

Cut face boards to allow continuous clearance (1/8″ to 1/4″) at floor. Apply DURABOND Joint Compound, USG Ready-Mixed Joint Compound—All Purpose or Taping at center and near each board edge in strips consisting of 4 beads, 3/8″ wide x 1/2″ high and spaced 1 1/2″ to 2″ o.c. Position boards vertically over wall surface, press into place and provide temporary support until adhesive is hardened.

trim accessory application

U.S.G.'s broad line of trim accessories simplifies and enhances the finishing of gypsum board assemblies. The accessories are low in cost, easily applied and designed to work together for

long-lasting, trouble-free construction. All are suitable for steel-frame and wood-frame construction.

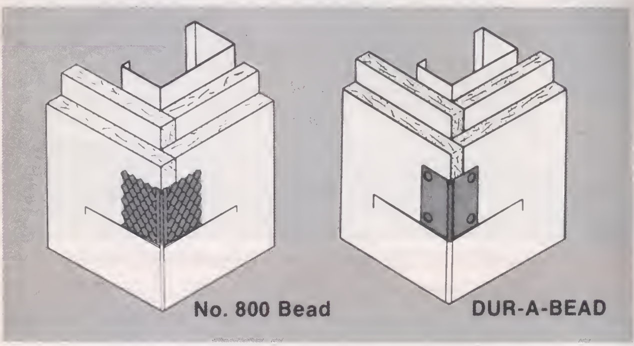
Corner Bead Application

Metal corner reinforcements provide strong, durable protection for outside angle corners, uncased openings, pilasters, beams and soffits. The exposed nose of the bead resists impact and forms a screed for finishing. Corner bead should be installed in one piece unless length of corner exceeds stock bead lengths. Install as noted for each product following.

Clinch-on tool crimps solid-flange beads into place.

Stapling is standard way to attach No. 800 Corner Bead.

For wood studs, nails in both bead flanges are also satisfactory.



nos. 800 and 900 corner bead, DUR-A-BEAD corner reinforcement

Drywall Construction—Apply DUR-A-BEAD with drywall nails, staples or screws spaced 9" o.c. in both flanges and placed opposite. Fasten to framing through board. Apply No. 800 Bead with staples (into board only) or nails spaced as for DUR-A-BEAD Reinforcement. No. 800 Bead provides exceptional bond and reinforcement. Solid-flange beads also may be attached with a "clinch-on" tool. For No. 104 (1⅛" x 1⅛") and No. 103 (1¼" x 1¼") DURABEAD, use correct size tool for flange width. Tool is not recommended for attaching No. 101 (1" x 1") DURABEAD Reinforcement. Finish corner with three coats of joint compound.

Veneer Construction—Apply No. 800 or No. 900 Corner Bead with nails or 9/16" galvanized staples spaced 12" o.c. through both flanges. Use No. 800 for one-coat applications, No. 900 for two-coat applications. On masonry corners, hold bead firmly

against corner and grout both flanges with IMPERIAL Finish. On monolithic concrete apply a high-grade bonding agent over corner before placing bead and grouting. Preset all beads with a veneer finish.

Metal Trim Application

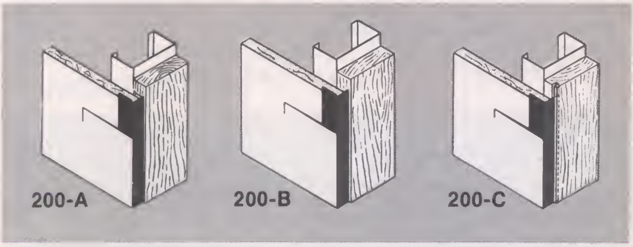
USG Metal Trim serves to protect and finish gypsum boards at window framing and door jambs; also used at ceiling-wall intersections and partition perimeters to form recess for acoustical sealant. Also serves as a relief joint at the intersection of dissimilar constructions such as gypsum board to concrete.

drywall construction

No. 200-A USG Metal Trim (½″ and ⅝″ size)—Apply gypsum panels, omitting fasteners at framing member where trim is to be installed. Leave a space ⅜″ to ½″ wide between edge of panel and face of jamb. This provides space for installation of hardware. Slip trim over edge of panel with wide knurled flange on room side and fasten trim and panel to framing. Use same type fasteners used to attach panels; space fasteners 9″ o.c. max. Finish with three coats of joint compound.

No. 200-B USG Metal Trim (½″ and ⅝″ size)—Apply gypsum panels same as for No. 200-A Trim, omitting fasteners and leaving ⅜″ to ½″ space at jamb. Place trim over edge of panel with knurled flange exposed. Attach trim and panel to framing with fasteners spaced 9″ o.c. max. Finish with three coats of joint compound.

No. 200-C USG Metal Trim—Adjustable for use with ⅝″, ½″ and ⅜″ panels, this L-shaped trim requires a slotted jamb. Before installation, kerf door and window jambs ⅛″ wide and ½″ deep, kerf being ⅜″ back from face of jamb. Apply gypsum panels same as for No. 200-A Trim, with edge of panel bordering kerf. Insert plain trim flange in kerf, with knurled flange over panel face. Attach trim and panel to framing with fasteners spaced 9″ o.c. max. Finish with three coats of joint compound.



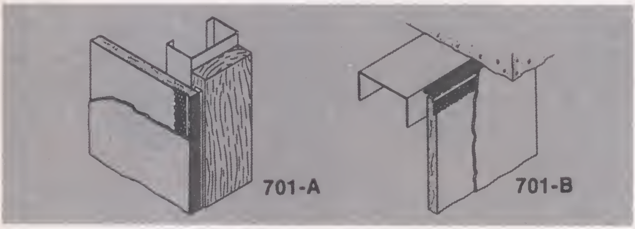
Nos. 400, 401 and 402 USG Metal Trim (⅜″, ½″ and ⅝″ size)—Apply trim to wall before gypsum panels go up, by nailing

through trim flange into framing; board is held firmly in place by short leg of trim. No additional edge fastening is necessary. Space fasteners 9″ o.c.

No. 400 Series

veneer construction

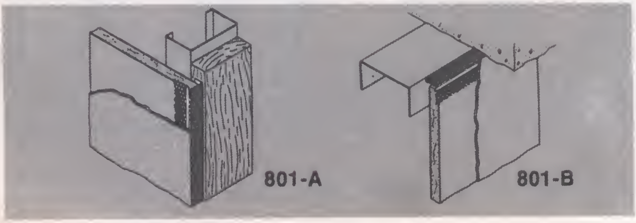
No. 701-A and 701-B USG Metal Trim (½″ and ⅝″ size)—Slip channel-type 701-A Trim over edge of base or position L-shaped 701-B Trim on edge of base with expanded flange on room side. Fasten with staples or nails 12″ o.c. max. Both trims are designed for two-coat veneer finish application.



701-A 701-B

drywall or veneer construction

No. 801-A and 801-B USG Metal Trim (½″ and ⅝″ size)—Slip channel-type 801-A Trim over edge of board, or position L-shaped 801-B Trim on edge of board with expanded flange on room side. Fasten with staples or nails 9″ o.c. max. for drywall applications; 12″ o.c. max. for veneer assemblies. Finish with three coats of joint compound or one-coat veneer.



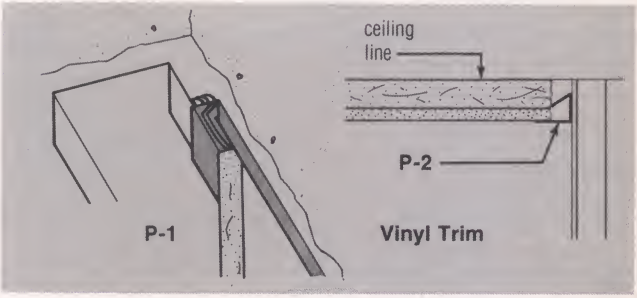
801-A 801-B

Vinyl Trim Application

For structural relief and effective sound control, USG Vinyl Trim finishes edges of gypsum panels and acts as a seal where the panel adjoins dissimilar structural surfaces. Install as follows:

USG P-1 Vinyl Trim (P-1A, ½" size; P-1B, ⅝" size)—Apply trim to edges of gypsum panels that will abut ceilings or walls. Slip trim over edges of panels for friction fit. Position panels, press trim edges against abutting surfaces for a snug contact and attach in conventional manner. Use same procedure for P-1A and P-1B.

USG P-2 Vinyl Trim—Provide ⅛" to ¼" relief at perimeter of radiant heated ceilings. Remove protective paper from adhesive on trim and insert trim into relief, with adhesive against wall surface. Press trim upward until long flange seats against ceiling.



TEXTONE Plastic Moulding Application

Solid-Color TEXTONE Plastic Mouldings (RP Series)—Available in four solid colors (ivory, tan, chocolate, black), these mouldings are used to cover panel joints and edges, protect corners and as trim around openings. These mouldings in ivory color are especially recommended where SHEETROCK Brand Panel surfaces are to be painted. (For installation, refer to Predecorated Panel Application—procedure is same as for TEXTONE Mouldings.)

control joints

Proper installation of control joints in wall and ceiling membranes should include breaking the gypsum boards behind the control joint. In ceiling construction, the framing should also be broken, and in partitions, separate studs should be used on each side of control joints. Control joints should be positioned to intersect light fixtures, air diffusers, door openings and other areas of stress concentration.

Gypsum construction should be isolated with control joints

where (a) partitions or ceilings of dissimilar construction meet and remain in the same plane; (b) wings of "L", "U" and "T" shaped ceiling areas are joined; and (c) expansion or control joints occur in the base wall construction and/or building structure. Just as important, control joints should be used in the face of gypsum partitions and ceilings when the size of the surface exceeds the following control-joint spacings; **Partitions,** 30 ft. maximum in either direction; **Interior Ceilings** (with perimeter relief), 50 ft. maximum in either direction; **Interior Ceilings** (without perimeter relief), 30 ft. maximum in either direction; and **Exterior Ceilings,** 30 ft. maximum in either direction; **Exterior Stucco Surfaces,** 10 ft. maximum in either direction.

Ceiling-height door frames may be used as vertical control joints for partitions; however, door frames of lesser height may only be used as control joints if standard control joints extend to the ceiling from both corners of the top of the door frame. When planning locations for control joints in the ceiling, it is recommended that they be located to intersect column penetrations, since movement of columns can impose stresses on the ceiling membrane.

Installation

At control joint locations:

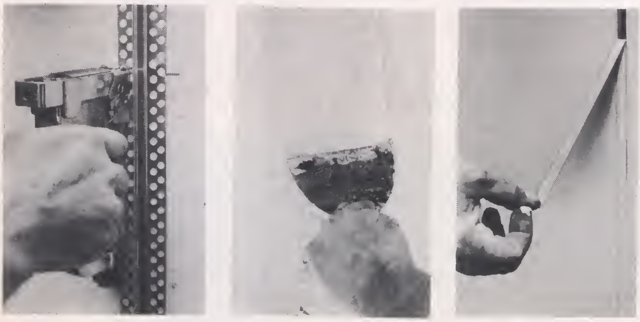
1. Leave a ½″ continuous opening between gypsum boards for insertion of surface-mounted joint.

2. Interrupt wood floor and ceiling plates with a ½″ gap, wherever there is a control joint in the structure.

3. Provide separate supports for each control joint flange.

4. Provide an adequate seal or safing insulation behind control joint where sound and/or fire ratings are prime considerations.

USG Control Joint No. 093—Apply over face of gypsum board where specified. Cut to length with a fine-toothed hacksaw (32 teeth per in.). Cut end joints square, butt together and align to



Control Joint No. 093 stapled, finished, tape removed.

Control Joint No. 093

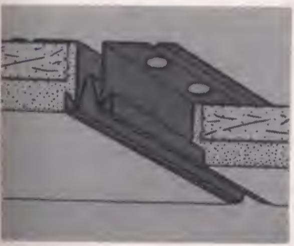
provide neat fit. Attach control joint to gypsum board with Bostitch 9⁄16″ Type G staples, or equivalent, spaced 6″ o.c. max. along each flange. Remove plastic tape after finishing with joint compound or veneer finish.

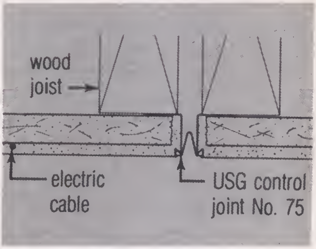
Max. Spacing—USG Control Joints

construction & location	max. single dimension		max. single area	
	ft	m	ft^2	m^2
partition—interior	30	9	—	—
ceiling—interior				
with perimeter relief	50	15	2500	230
without perimeter relief	30	9	900	85
ceiling—exterior gypsum	30	9	900	85
walls, soffits—exterior stucco	10	3	100	9

USG Control Joint No. 75—Apply to bottom of double row of wood joists in radiant-heated ceilings before USG R.H. Base is applied. Attach control joint to joists with Bostitch 9⁄16″ Type G staples or nails spaced 6″ o.c. max. along each flange. Splice end joints with two pieces 16-ga. galvanized tie wire inserted in the sections. Apply R.H. Base over control joint attachment flange and fasten to joist with proper fastener (see fastener selector guide in Chapter 1). Space nails 7″ o.c., screws 12″ o.c. Use control joint as a screed for applying DIAMOND Interior Finish. Remove plastic tape after veneer application.

Control Joint No. 75 supports base, serves as plaster screed.





joint treatment application—drywall construction

Application Conditions

In cold weather during joint finishing, temperatures within the building should be maintained within the range of 55° to 70°F. (13° to 21°C) and adequate ventilation should be provided as described earlier in this chapter. Also see "Quality Drywall Finishing in All Kinds of Weather", U.S.G. folder J-75.

Check Working Surfaces

Gypsum panels must be *firmly* fastened to framing members without cutting the surface paper or fracturing the core. Make certain panel joints are aligned. When one panel is higher than another it becomes difficult to leave sufficient compound under the tape covering the high panel. Blisters, bond failure and cracks can easily develop in these areas.

Open spaces between panels of 1/4" or more should be filled with compound at least 24 hours prior to embedding or first-coat work. DURABOND Joint Compounds, which are hardening types, are recommended for these large fills. With DURABOND as a fill, joint treatment may begin as soon as the compound has hardened, eliminating the typical 24-hr. drying period. Good planning prior to hanging panels eliminates unnecessary joints.

Care of Equipment

Applicators *must* keep tools and equipment clean and in good repair to secure satisfactory results. With mechanical tools, parts *must* be replaced as soon as they show signs of wear.

Mixing joint compounds in dirty buckets or failure to wipe down bucket as material is used causes lumps, scratches and usually creates hard working material. With hardening-type materials such as DURABOND Joint Compounds, a residue of dry compounds will shorten hardening time of the new batch.

The hardening action of DURABOND Joint Compounds requires that all tools, mixing containers, bread pans, etc., used for application be thoroughly cleaned. Flush and clean these compounds from equipment with a conventional garden hose and brush before the hardening action takes place. *Immersion of equipment in water will not prevent hardening of the compound.*

Mechanical tool application is not recommended with fast-setting DURABOND Joint Compounds.

Mixing Joint Compounds

1. Mix powder joint compounds in a clean 5-gal. container (preferably plastic for DURABOND Joint Compounds since plastic permits flexing container walls to break loose hardened compound). A commercial potato masher makes a convenient mix-

ing tool. Power mixing saves considerable time, particularly where mixing in a central location is convenient. Power may be supplied by a ½″ heavy-duty electric drill operating at 200 to 300 rpm (400 rpm max.). Drills operating at high speeds whip air into the compound, and also accelerate hardening of DURABOND Compounds. Mixing paddles are open-cage type (see Chapter 8—Tools). Keep mixing buckets and tools clean at all times. Containers having any residue of joint compounds in them may cause premature hardening, scratching and incompatibility problems.

2. Pour proper amount of clean drinkable water into container. Dirty water (such as that used to clean tools) will contaminate compound and cause erratic hardening of DURABOND Compound. The amounts for type of application and product used are shown on the container.

3. Sift joint compound into water, allowing complete wetting of the powder.

4. Mix as shown below:

a. For DURABOND Joint Compounds, stir vigorously for approx. 3 min., making sure all compound is uniformly wet. Do not overmix; this may speed up hardening time. Allow the mix to soak for approx. 15 min. Remix the compound until smooth, and it is ready to use. *Note:* Keep the compound from being contaminated by any other materials such as other type joint compounds, dirty water or previously mixed DURABOND Joint Compound. Contamination will affect the hardening time and properties of the compound. Do not remix if product has started to harden.

Mix only as much DURABOND Joint Compound as can be used within time period shown on bag (usually 3 to 6 hours for 210, 1 to 2 hours for DURABOND 90, for example).

The compound will harden chemically after this time period, even under water. Do not attempt to hold wet mix or immerse joint compound-coated tools in water to hold back hardening. Retempering the compound is not recommended.

b. For USG Powder Joint Compounds, stir until the powder is uniformly damp, then after approx. 15 min., remix vigorously until smooth. *Note:* Do not add extra water. Use specified amounts of water, as USG Joint Compounds will retain their original mixed consistency over extended periods. On occasions, some slight liquid separation or settlement of compound may take place in the bucket, but a brief remix will restore the compound to its original consistency.

c. For USG Ready-Mixed Compounds, mix contents lightly and use at package consistency for fasteners and corner beads. May be thinned for taping and finishing and for use with mechanical tools. Add water in half-pint increments to avoid overthinning. Remix *lightly* and test apply after each water addition. A potato masher-type mixer is recommended for Ready-Mixed Compounds. Drill-type mixers tend to whip air into the compounds.

Use cool to lukewarm (not hot) water. If compound should

accidentally be overthinned, simply add additional Ready-Mixed Compound to thicken, then remix.

To hold the wet mix in a container for prolonged periods, cover the material with a wet cloth or a thin layer of water. When needed, pour off water and retemper as necessary.

Ready-Mixed Compound is sensitive to cold weather and must be protected from freezing. If material freezes in container, allow it to thaw at room temperature (do not force the thawing process). Usually it will again be usable, *unless* it has been subjected to several freeze-thaw cycles.

Ready-Mixed Compound can be used in tools and containers previously used for powder compound after normal cleaning.

Hand Tool Application

Pre-filling Joints—Pre-fill the "V" groove between SHEETROCK Brand SW Gypsum Panels (diagram, above) with DURABOND 45 or 90 Joint Compound. Apply compound directly over "V" groove with a flexible 5″ or 6″ joint finishing knife. Wipe off excess compound that is applied beyond the grocve. Allow pre-fill compound to harden. (This step is necessary with SW-edge board only.)

Pre-filling "V" joint of SHEETROCK Brand SW Gypsum Panels.

Buttering Joints—Check all nails by drawing finishing knife across fasteners. Drive home protruding fasteners in panels, leaving a dimple in surface paper. Using a broad steel finishing knife, butter taping or all-purpose joint compound into channel formed by tapered edges of panels, filling channel fully and evenly (above, left). Avoid heavy fills which increase the possibility of excessive shrinkage and check cracking.

Embedding Tape—Center PERF-A-TAPE Reinforcement and press it down into fresh joint compound. Holding knife at an approx. 45° angle to board, draw knife along joint with sufficient pressure to remove excess compound (above, right). Leave sufficient compound under tape for proper bond but not over 1/32″ under edge. *Do not* use topping compound for embedding tape.

Covering Tape—When tape is embedded, apply a skim coat of joint compound immediately after embedding (left, below). This skim coat reduces the possibility of edge wrinkling or curling which may lead to edge cracking. Allow to dry completely. (See "Drying Time Guide," found later in this chapter.)

Spotting Fastener Heads—Apply first coat of joint compound over all fastener heads (above, right) immediately before or after embedding tape. Apply enough pressure on knife to finish compound level with board surface.

Filling Beads—Apply first fill coat of compound over all corner beads (below) and to trims that are to receive compound.

Second Coat Application—After all first-coat compound is completely dry (about 24 hr. under good drying conditions), apply a second coat. Over tape, bead and trim, feather second coat

approx. 2″ beyond edge of first coat (shown below). Spot fastener heads with second coat of compound. Allow to dry. Smooth lightly if necessary. *Do not* scuff paper by oversanding.

Second-coat application

Third-coat application

Third Coat Application—After second coat is dry, sand lightly. Apply a thin finishing coat to joints, fastener heads, beads and trim. Feather edges of third coats at least two inches beyond edges of second coats. Smooth lightly when dry. *Do not* scuff face paper by oversanding. Open-weave silicon carbide sanding cloth in 100, 200 or 220 grit, is recommended for best results. It minimizes nap-raising of the face paper and joint decoration problems. Open-coat sandpaper also produces satisfactory joints. Use #80 grit for first and second coats and #100 grit for finish coat. Remove all dust before decorating.

Wet-sanding or sponging finished joints is recommended rather than dry sanding to avoid creating dust. If dry sanding, mixing or otherwise working in a dusty atmosphere containing this material, ventilate, use dust collector, or wear eye protection and a respirator approved by the Bureau of Mines, or equivalent, to remove dust.

End Joints—Butt or end joints are treated much the same as tapered joints. When SHEETROCK Brand Panels are applied, end joints should be loosely butted together. Apply compound over joint and embed tape as described for tapered joints. Take particular care to leave sufficient compound under tape for continuous bond and blister prevention. Apply tape covering, second, and third coats in same manner as for tapered joints. Finishing coats of joint compound must be feathered wider (approx. 18″), than for edge joints because there is no taper in which to embed tape.

Finishing Inside Corners—Fold tape along center crease. Butter both sides of corner with joint compound and apply tape (left, above). Apply second and third coats of compound (one side at a time) in same manner as for finishing flat joints.

The PERF-A-TAPE Corner Tool with two blades specially angled to work the 90° inside corners may be used (shown, right above). Application procedure is the same, but tape and compound can be applied on both sides in one operation. Corner tool is angled slightly so about 1½" of blade tips contact the corner. After embedding tape, remove excess compound with tip of either blade. Final finishing is done with long continuous strokes.

Mechanical Tool Application

Several types of mechanical and semi-mechanical tools are available. Tools used in the following sequence illustrate typical procedures.

1. Using compound of suitable consistency, mechanically tape all joints; wipe down with broad knife (above). Allow to dry.

2. Mechanically tape interior angles. Finish both sides of angles with corner roller and corner finisher as shown above. Touch up with broad knife as necessary. Apply first coat to fastener heads and metal accessories. Allow to dry.

3. Apply second coat of compound over tape on flat joints using hand finisher tool (above). Using compound of thicker consistency, spot fastener heads and apply second coat to metal accessories. Allow to dry.

4. Apply third coat of compound to flat joints, feathering edges about 2″ beyond preceding coat. Apply finish coat to metal accessories and fastener heads. Allow to dry and smooth lightly as required. Remove all dust before decoration. *Do not* scuff face paper by oversanding.

Finishing

To improve fastener concealment where gypsum panel walls and ceilings will be subjected to severe artificial or natural side lighting and be decorated with a water-based paint, apply a good quality alkyd (oil) based primer/sealer prior to decoration. However, when using this procedure, care should be taken to avoid roughening the surface paper if sanding is used to smooth the joint compound. For priming and decorating, follow manufacturer's directions for materials used.

DURABOND Joint System Application

DURABOND Joint Compounds are chemical hardening products with varied working (setting) times for finishing interior gypsum panels and exterior gypsum ceiling boards. These specialized products provide short hardening times for fast one-day finishing and extended times (up to 6 hours) to suit individual needs. Products with shorter working times have lower shrinkage. The following application guide will help you choose the proper product to meet your requirements.

Application Guide—DURABOND Joint Compounds

compound type	setting time—min.	working time—min.	recommended application
45	30-60	20	prefill SW panels spot fastener heads embed metal beads
90	85-130	60	all applications
150	120-180	90	embed joint tape second (fill) coat embed metal beads
210	180-360	150	embed tape embed metal beads
300	240-360	210	application needing longer working time

For One-Day Finishing—Use the techniques shown for hand application; mechanical tool application is *not recommended* for DURABOND Compounds because these compounds may harden in the tools, making them inoperable. In the following sequence, Steps 1 through 4 must be completed by mid-day. Planning and scheduling according to the hardening times of the compounds are essential.

(Where SHEETROCK Brand SW Panels are used, the first step is to fill the "V" grooves between panels.)

1. Embed tape over all joints and angles.

2. Spot fastener heads throughout job.

3. Apply second (fill) coat over all joints and angles as soon as taping coat has hardened (even though not dry).

4. Apply compound over metal corner reinforcement. For best results use compound that will set within 1½ to 2 hours. Use either previously mixed material or faster setting compound. Apply second coat to all fasteners.

5. After the second (fill) coat application has hardened, apply finishing coat of selected finishing compound to completely cover all joints, angles, corner bead and fasteners.

For USG Exterior Ceiling Board Surfaces—Use hand application techniques and a DURABOND Joint Compound to treat joints and fasteners in USG Exterior Ceiling Board applications. During periods of near-freezing temperatures, check weather forecast

before beginning work. Minimum air, water, mix and surface temperatures of 45°F. (7°C) must be assured until compound is completely dry. Apply DURABOND Joint Compound in the following sequence:

1. Pre-fill joints of USG Exterior Gypsum Ceiling Board with a DURABOND Compound. After pre-fill has hardened, tape all joints and angles in the ceiling with DURABOND and PERF-A-TAPE Reinforcement. When compound hardens, immediately apply a fill coat of a DURABOND Compound; allow to harden before finishing.

2. Apply DURABOND over flanges of USG Control Joints, metal beads and trim. Spot all fastener heads.

3. After fill coat has hardened, apply DURABOND Compound finishing coat. Completely cover all joints, angles, beads, control joints and fasteners.

4. After the DURABOND Compound joint has dried, apply one coat of a good-quality oil or alkyd-based exterior primer. Then follow with at least one coat of a good-quality alkyd or latex exterior paint.

Drying Time—Joint Compound Under Tape

RH	RH = Relative Humidity D = Days (24 hr.) H = Hours							
98%	53 D	38 D	26 D	18 D	12 D	9 D	6 D	4½ D
97%	37 D	26 D	18 D	12 D	9 D	6 D	4½ D	3¼ D
96%	28 D	21 D	14 D	10 D	7 D	5 D	3½ D	2½ D
95%	25 D	17 D	12 D	8 D	6 D	4 D	2¾ D	2 D
94%	20 D	14 D	10 D	7 D	5 D	3¼ D	2¼ D	41 H
93%	18 D	12½ D	9 D	6 D	4 D	2¾ D	2 D	36 H
92%	15 D	11 D	8 D	5 D	3½ D	2½ D	44 H	32 H
91%	14 D	10 D	7 D	4¾ D	3¼ D	2¼ D	40 H	29 H
90%	13 D	9 D	6 D	4½ D	3 D	49 H	36 H	26 H
85%	10 D	6 D	4 D	3 D	2 D	34 H	25 H	18 H
80%	7 D	4¾ D	3¼ D	2¼ D	38 H	27 H	19 H	14 H
70%	4½ D	3½ D	2¼ D	38 H	26 H	19 H	14 H	10 H
60%	3½ D	2½ D	42 H	29 H	20 H	14 H	10 H	8 H
50%	3 D	2 D	36 H	24 H	17 H	12 H	9 H	6 H
40%	2½ D	44 H	29 H	20 H	14 H	10 H	7 H	5 H
30%	2¼ D	38 H	26 H	18 H	12 H	9 H	6 H	4½ H
20%	2 D	34 H	23 H	16 H	11 H	8 H	5½ H	4 H
10%	42 H	30 H	21 H	14 H	10 H	7 H	5 H	3½ H
0	38 H	28 H	19 H	13 H	9 H	6 H	4½ H	3 H
°F	32°	40°	50°	60°	70°	80°	90°	100°
°C	0°	4°	10°	16°	21°	27°	32°	38°

This standard is based on evaporation of 10 lb. water per 250 ft. reinforcing tape, corresponding to 1⁄16″ to 5⁄64″ wet compound thickness under the tape. The drying times for thicker (or thinner) coats of wet compound between tape and panels will increase (or decrease) in proportion to the wet compound thickness.

These drying times apply when the exposed surface of tape is bare or nearly bare, and when adequate ventilation is provided. A heavy compound coat over tape lengthens drying time.

joint treatment application—veneer construction

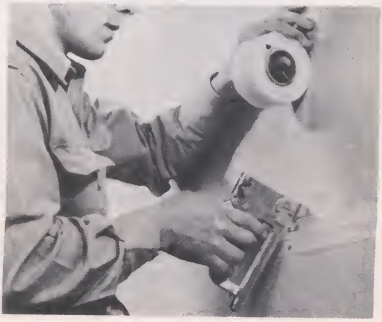
Conventional Method

For Normal Drying Conditions—Align IMPERIAL Type P (pressure-sensitive) Tape over joint and press into place over entire length. Eliminate wrinkles and assure maximum adhesive bond by pressing entire length of tape with steel finishing knife or trowel. Press tape into corners with corner tool; do not overlap.

Simplified, wrinkle-free attachment of self-stick Type P IMPERIAL Tape speeds joint reinforcing, boosts production.

Or, attach IMPERIAL Type S Tape with spring-driven hand stapler using 3⁄8″ staples. Use two staples at each end of tape;

Lower-cost Type S IMPERIAL Tape is rapidly stapled over flat joints at staggered intervals. High-strength glass fibers and open weave of tape provide for excellent keying of veneer plaster during embedding.



staple remainder at staggered 24″ intervals. At wall-ceiling angles, staple every 18″ to 24″ along ceiling edge only. For wall-to-wall interior angles, staple every 18″ to 24″ on one edge only, working from top to bottom. Position tape to bridge the joint at all interior corners without overlapping.

Embed tape and fill beads with coat of veneer plaster being used, and allow to set—*but not dry*—prior to veneer plaster application. Slightly underfill in the bead by screeding along the bead with edge of trowel after setting the bead. (Best results are obtained by planning the finishing to permit continuous application from angle to angle.)

Alternate Method

For Rapid Drying Conditions—When building temperature-humidity conditions fall in the "rapid drying" area of the graph (page 145), use PERF-A-TAPE Joint Reinforcing Tape embedded with a DURABOND Joint Compound.

Mix the compound in a clean 5-gal. container (plastic is preferred for DURABOND). Use a commercial potato masher or a ½″ heavy-duty 200- to 300-rpm electric drill with a cage-type paddle. Drill speed must not exceed 400 rpm. Use the amount of water shown on the bag and *always* sift the powder into the water to insure complete wetting. Stir vigorously for 3 min.; if lumps remain, allow the mix to soak for approx. 15 min., then re-stir until smooth. *Note:* Do not contaminate compound with other materials, dirty water or previous batches. Do not retemper batches.

Butter joints with compound using a trowel or steel finishing knife to force compound into the joints. Center PERF-A-TAPE over joint and press it into the fresh compound with trowel held at a 45° angle. Draw trowel along joint with sufficient pressure to remove excess compound.

After tape is embedded, apply a skim coat of joint compound to reduce possibility of edge wrinkling or curling. Allow skim coat to harden, then apply a fill coat, feathering 3″ to 4″ beyond edges of tape. Allow to harden before finishing. Plaster pre-fill is not required over DURABOND Compound.

Note: Under the following conditions a DURABOND Joint Compound and PERF-A-TAPE Reinforcement (alternate method) must be used: (1) where two-coat finish is applied over ½″ or ⅝″ base on 24″ o.c. framing; (2) where one-coat DIAMOND Interior Finish or IMPERIAL Finish is applied over ⅝″ base on 24″ o.c. framing.

veneer finish application

Veneer finishes can be used in one- or two-coat applications and can be given smooth or textured surfaces. Each method has its particular advantage.

Two-Coat Veneer Finish—Compared to many other finishes, two-coat veneer provides a more durable, abrasion-resistant surface and can be finished to a truer plane than one-coat

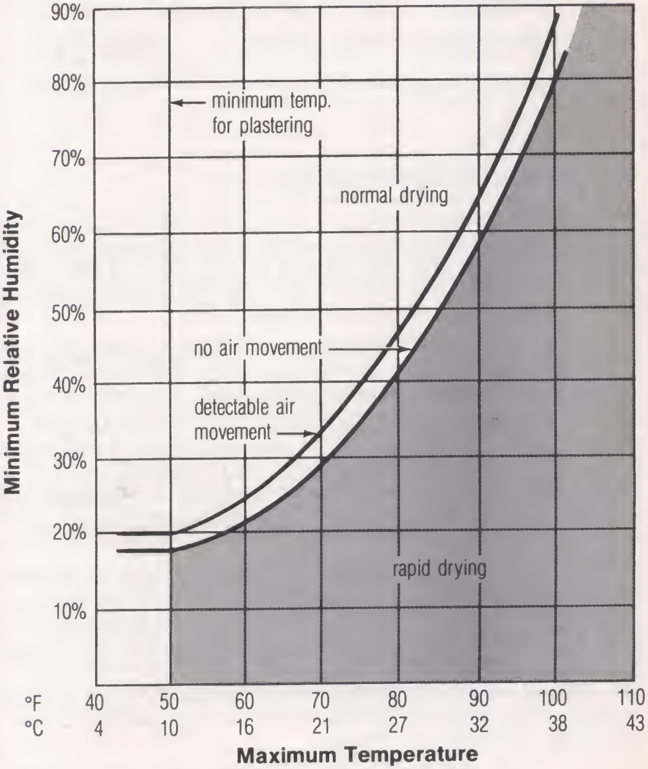
applications. These finishes can be used with steel or wood framing wherever the ultimate in appearance is desired. Ready for next-day decorating, assemblies with these monolithic gypsum surfaces offer excellent fire and sound ratings.

One-Coat Veneer Finish—Provides a hard monolithic surface at low cost. Complete application—from bare studs to decorated walls and ceilings—takes no more than 48 to 72 hr. Assemblies with one-coat veneer application meet fire and sound requirements, and shorten construction schedules for added profit.

Job Environment

Maintain building temperature in minimum comfortable working range, about 55 to 60°F. (13° to 16°C). Keep air circulation at minimum level prior to, during and following application until finish is dry.

Drying Conditions—Veneer Finishes



If possible, maintain building temperature-humidity combination in the "normal drying" area of the graph. When dry conditions exist, relative humidity often can be increased by wetting down

the floor periodically. During these periods, make every effort to reduce air movement by closing windows and deflecting heater blower and duct output away from the surfaces being plastered.

If building temperature-humidity combination is in the "rapid drying" area of the graph, special joint treatment measures must be taken. These include the use of DURABOND 45 or 90 Joint Compound which are faster hardening and PERF-A-TAPE Reinforcing Tape.

Grounds

Correct thickness of veneer finish is one of the most important factors in obtaining good results. To insure proper thickness, all corner beads, trim and expansion joints must be of the recommended type and be properly set.

Accessories must provide grounds for the following minimum plaster thicknesses:

1. Over veneer gypsum base, one coat........ 1⁄16 in. (1.6 mm)

2. Over veneer gypsum base, two coats....... 3⁄32 in. (2.4 mm)

Mixing and Proportioning

All veneer finishes require the addition of water on the job. Water should be clean, fresh, suitable for human consumption, and free from mineral and organic substances that affect the plaster set. Water used for rinsing or cleaning *is not suitable* for mixing because it accelerates the plaster set.

Mechanical mixing is mandatory for veneer finishes. Mix no more material than can be applied before set begins. Since veneer finishes set more rapidly than most conventional plasters, always consult bag directions for specific setting times.

Veneer plasters and finishes will produce mortar of maximum performance and workability when the correct equipment is used and mixing directions carefully followed. Proper mixing is one of the most important factors in producing mortar of maximum workability.

Use a *cage-type mixer paddle* driven by heavy-duty ½" electric drill with a no-load rating of 900 to 1,000 rpm. Do not use propeller-type paddle or conventional mortar mixer. (For details of the cage-type mixing paddle and available electrical drills, see U.S.G. technical data sheet P-502.)

Mix plaster in 16 or 30-gal. smooth-sided container strong enough to withstand impacts that could cause gouging. Do not use brittle containers for mixing.

Correct mixing—rapid and with high shear action—is essential for proper dispersion of plaster ingredients. Slow mixing can reduce plasticity of material. Overmixing can shorten working time. Operated at correct speed, the cage-type design paddle mixes thoroughly without introducing excess air into the mix.

Cage-type mixing paddle is designed to draw material into and through paddle blades to disperse and blend ingredients by shear action rather than folding action of conventional mixers.

DIAMOND interior finish mixing

Water requirement for DIAMOND Interior Finish is 12 to 15 qt. of clean water per 50-lb. bag. Place all but 1 or 2 qt. of water into mixing container; then with mixer operating, slowly add one bag of material. If a texture finish is desired, up to 50 lb. clean silica sand may be added per 50-lb. bag of plaster. For electric cable heat systems, clean, sharp, fine silica sand must be added as follows: *fill coat,* 50 lb. but no less than 25 lb. per 50-lb. bag plaster; *finish coat,* at least 12½ lb. per 50-lb. bag plaster. When material is wetted, add more water (1 to 2 qt.) to obtain desired consistency. Mix for minimum of two minutes, but *no longer than five minutes.*

When DIAMOND Finish is job-aggregated, one tablespoon cream of Tartar should be added for each bag of Finish to retard plaster and allow sufficient working time.

IMPERIAL plasters

Water requirements for IMPERIAL Veneer Plasters:

IMPERIAL Basecoat—8 to 10 qt./80 lb. bag.

IMPERIAL Finish—11 to 13 qt./80 lb. bag.

Place water in a 12- to 16-gal. smooth-sided container. Start mixer, slowly add plaster and mix at least 2 min. to disperse lumps completely. Do not mix more than 5 min.

For sand float finish, add up to 20 lb. clean silica sand per 80-lb. bag of IMPERIAL Plaster to achieve desired texture. The use of more than 20 lb. of sand per bag will decrease hardness of surface. (Apply plaster in normal manner but omit final troweling. After surface has become firm, float to desired texture, using sponge, carpet or other float. Use water sparingly.)

Application

Maintain temperature in all work areas at min. 55 to 60°F. (13° to 16°C). Keep air circulation at minimum level during and after application until finish is dry.

DIAMOND interior finish

All finish materials and finish surfaces must be protected from contact with DIAMOND Interior Finish. This includes glass, ceramic materials, metal and wood. Apply wood, plastic or other exposed trim after plaster application.

DIAMOND Interior Finish should be applied to IMPERIAL Gypsum Base having unfaded blue face paper. However, under abnormal conditions where there is no alternative to using gypsum base faded from excessive exposure to sunlight or ultra-violet radiation, precautions should be taken to prevent delamination. Degraded gypsum base is indicated if face paper is not blue or grayish blue. When face paper color has become gray to tan, treat paper with an alum solution or bonding agent. Degrading may occur when gypsum base has been installed long before the finish is applied.

For alum solution treatment, dissolve 3 lb. of alum in one gallon of water. Pour alum slowly into water and mix thoroughly. Allow solution to stand until any undissolved material has settled; then strain solution into tank-type sprayer (such as a lawn and garden sprayer). Spray solution on faded base so that it is wet but not soaked. One gallon of solution should treat 750 sq. ft. of base. Begin finish application before alum solution is completely dry. *Note:* Alum treatment shortens setting time of DIAMOND Interior Finish.

Begin application only after joints have been reinforced with glass fiber tape and preset with an application of DIAMOND Interior Finish (or treated with PERF-A-TAPE Reinforcement and DURABOND Joint Compound). Apply a thin, tight scratch coat of this finish over entire working area. Immediately double back with material from same batch to a full $1/16''$ to $3/32''$ thickness.

Start the finish troweling as soon as material has become sufficiently firm to achieve a smooth trowel finish free from trowel marks, voids and other blemishes. Smooth and level the surface with trowel held flat; use water sparingly to lubricate. Final hard troweling should be accomplished prior to set as indicated by darkening of the surface.

A variety of textures ranging from sand float to heavy Spanish can be achieved with DIAMOND Interior Finish when job-aggregated with silica sand. Application is the same as for neat DIAMOND Interior Finish except that once the surface has been leveled and sufficient take-up has occurred, begin floating material from the same batch with trowel, float, sponge or by other accepted local techniques.

DIAMOND Interior Finish also may be textured by skip-troweling. When applying in this manner, eliminate final troweling. When surface has become sufficiently firm, texture with material from same batch prior to set.

DIAMOND Interior Finish is intended for hand application over veneer basecoats, as well as direct to gypsum base as a one-coat system. Machine application is not recommended. When applied over veneer basecoat, be certain basecoat is *not* completely dry. Basecoat should be set and allowed to dry only partially to provide suitable suction.

radiant heat plaster system

Application—Radiant Heat Cable—After USG R.H. Base and joint reinforcement tape have been applied, install electric radiant heating cable in accordance with design requirements and cable manufacturer's specifications. Attach cable to ceiling in such a manner that it is kept taut and does not sag away from the base. All cable connectors and non-heating leads should be embedded into (countersunk), but not through, the R.H. Base so they do not project below the heating wire.

Application—Fill Coat—Apply job-sanded DIAMOND Interior Finish in sufficient thickness to completely cover cable. Trowel plaster parallel to direction of cable but do not use cable as a screed. Level with a trowel, rod or darby to fill any low spots or to remove any high ridges, etc. Use a serrated darby or lightly broom the plaster surface prior to set to provide a key for the finish coat. Average thickness of fill coat should be 3/16″.

Application—Finish Coat—Apply finish coat after fill coat has developed sufficient suction (in good drying weather, about two hours after the fill coat has set) (in damper or cold weather usually overnight unless good supplementary heat and ventilation are provided). Use job-sanded DIAMOND Interior Finish Plaster 1/16″ to 3/32″ thick, to bring total plaster thickness to 1/4″. Scratch in a tight thin coat over the entire area, immediately doubling back to full thickness. Fill all voids and imperfections. Scratch and double-back with the same mix of DIAMOND Interior Finish. When surface has become firm, hold trowel flat and final-trowel using water sparingly. Best results are obtained by continuous application of an entire ceiling. Always work to a wet edge to avoid dry joinings.

Texture Finish—When finish coat has become sufficiently firm, but unset, float surface to desired texture using a sponge, carpet, or other float. Use water sparingly. For heavier texture, additional material from the same batch may be applied to the firm surface to achieve a skip-trowel, Spanish, or other texture.

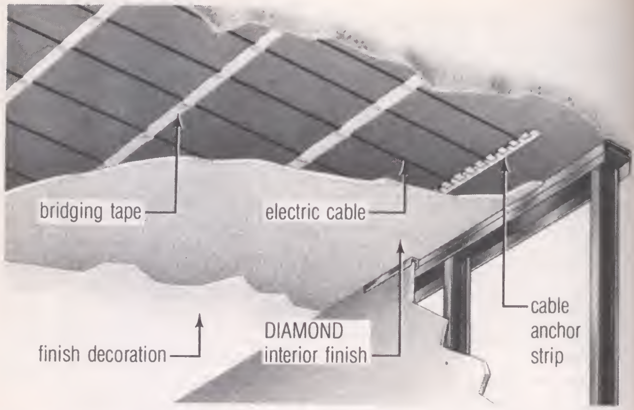
Simulated Acoustical Finish—Spray-apply max. 1/8″ thickness of IMPERIAL QT Texture Finish or similar product over a full 1/4″ thickness of sanded DIAMOND Interior Finish Plaster. Follow manufacturer's specifications.

Use of this finish at the maximum 1/8″ thickness will slightly decrease heating system efficiency since simulated acoustical finishes are formulated with insulating-type aggregates.

radiant heat systems to monolithic concrete

Surface Preparation—Concrete surface must be structurally sound and clean, free of dirt, dust, grease, wax, oil or other unsound conditions. Treat exposed metal with a rustproof primer. When corrosion due to high humidity and/or saline content of sand is possible, the use of zinc alloy accessories is recommended.

Remove form ridges to make surfaces reasonably uniform and level. Locate uneven ceiling areas and bad gravel pockets, which require filling prior to installing electric cable and filler.



After treating entire surface with a plaster bonding agent, according to manufacturer's directions, leveling may be done with fill-coat mix of DIAMOND Interior Finish Plaster. Minor leveling may be done with a DURABOND Joint Compound.

Caution: Temperature of concrete ceiling with bonding agent applied must be above 32°F. (0°C) before filler and finish applications are started, with air temperature above 55°F. (13°C).

Application—Radiant Heat Cable—After ceiling surface has been leveled, apply electric radiant heating cable according to design requirements and cable manufacturer's specifications. Attach cable to the ceiling so that it is kept taut and does not sag away from the ceiling. All cable connectors and non-heating leads must be securely attached to concrete ceiling.

Finishing—Mix and apply job-sanded fill coat DIAMOND Interior Finish Plaster according to directions in previous section. Apply 5⁄16" basecoat parallel to direction of cable, completely covering cable and anchor devices.

Mix and apply finish coat after fill coat has developed sufficient suction. Use job-sanded DIAMOND Interior Finish Plaster 1⁄16" to 3⁄32" thick, to bring total plaster thickness to 3⁄8". Apply finish coat in same manner described in previous section.

Do not energize heating cable until plaster is thoroughly dry. When either or both the completed radiant heat ceiling and room temperature are below 55°F. (13°C), the thermostatic elevations should be made in 5°F. (3°C) increments for each 24-hr. period until a room temperature of 55°F. (13°C) is attained.

If completed radiant heat ceiling and room temperature are 55°F. (13°C) or higher, thermostat may be set at desired temperature.

IMPERIAL plasters

Hand Application—Embed IMPERIAL Tape and fill beads with a tight, thin coat of IMPERIAL Plaster; allow to set, then plaster.

Best results are obtained by planning the plastering to permit continuous application from angle to angle. Where joining is

unavoidable, use trowel to terminate unset plaster in sharp clean edge—do not feather out. Bring adjacent plaster up to terminated edge and leave level. Do not overlap. During finish troweling, use excess material to fill and bridge joining.

One-Coat (one-bag system)—Scratch in a tight, thin coat of IMPERIAL Finish over entire area, immediately doubling back with plaster from same batch to full thickness of 1/16″ to 3/32″. Fill all voids and imperfections. Final-trowel after surface has become firm, holding trowel flat and using water sparingly. Do not over-trowel.

Two-Coat (two-bag system)—Scratch in a tight, thin coat of IMPERIAL Basecoat over entire area, immediately doubling back with plaster from same batch to full thickness of 1/16″ to 3/32″. Fill all voids and imperfections. Leave surface rough by cross-raking with a fine wire rake or broom. Allow basecoat to set to provide proper suction for finish coat.

Finish Coat—Scratch-in and double-back with IMPERIAL Finish, DIAMOND Interior Finish, gauged lime-putty, STRUCTO-GAUGE Gauging-lime, RED TOP Finish or Keenes Cement-lime-sand finishes to fill out to a smooth, dense surface for decoration, free of surface blemishes, to a full thickness of 1/8″. Final-trowel IMPERIAL Finish after surface has become firm, holding trowel flat and using water sparingly. Do not over-trowel.

Machine Application—IMPERIAL Basecoat requires special equipment that provides for automatic catalyst injection. The machine should be operated in strict accordance with the manufacturer's directions. Successful results require advance job planning and operator training.

The plaster base should be protected from overspray or contamination by lime or casein materials. Such materials adversely affect the bonding characteristics of plaster. Mask all areas to be protected from plaster overspray with plastic sheeting or paper secured with masking tape.

Catalyst—Mix one to three 3-lb. bags of IMPERIAL Catalyst in 3 gal. of clean water in a plastic pail. The amount of catalyst used will be determined by the desired setting time. Stir until material dissolves, let residue settle and pour solution into accelerator tank of the machine.

Mix basecoat as previously described and pour into the machine through the 8×8-mesh screen hopper. Adjust water in mix until 75% to 90% will pass the screen without shaking.

Caution: Clean mixing equipment after each batch. Clean hopper and screen free of set plaster to avoid acceleration. Machine should be completely cleaned after each four hours of use.

Adjust setting time by controlling catalyst flow at the machine. Test by spraying finish on gypsum base scrap.

Joint Treatment—With setting time adjusted to 30 min., spray joints to which glass fiber IMPERIAL Tape Type S or P has been applied and all corner-bead and trim flanges in a pattern wide enough to cover the tape and flanges. Immediately trowel level, completely embedding tape and covering flanges. Leave no

voids. Allow to set before plastering. This initial spraying is not required over DURABOND Joint Treatment.

Finish Coat—Scratch-in and double-back with IMPERIAL Finish, DIAMOND Interior Finish, gauged lime-putty, STRUCTO-GAUGE Gauging-lime, RED TOP Finish or Keenes Cement-lime-sand finishes to fill out to a smooth, dense surface for decoration, free of surface blemishes, to a full plaster thickness of ⅛". Final-trowel IMPERIAL Finish after surface has become firm, holding trowel flat and using water sparingly. Do not over-trowel.

Spray Texture Finish—Mix Keenes Cement-lime-sand in proportion of 100 lb. Keenes to 50 lb. dry hydrated lime and 400 lb. clean white silica sand, with sufficient water to form a smooth consistency. Apply this mix over IMPERIAL Basecoat surface, which is free of ridges or other imperfections, with either a hand-held hopper gun or machine application equipment without catalyst. Vary aggregate grading, number of passes over the surface, air pressure and nozzle orifice as necessary to achieve desired texture.

Concrete Block—Surface must develop proper suction or be roughened to provide adequate mechanical bond. Lightly spray walls with water to provide uniform suction. Fill and level all voids, depressions and joints with IMPERIAL Basecoat and allow to set; then apply subsequent coats as described above.

predecorated panel application

The use of predecorated gypsum panels takes full advantage of the real economy of fire-resistant gypsum panels in providing highly serviceable, quickly installed decorative walls. With vinyl-faced TEXTONE Gypsum Panels, walls resist stains and scuffs, are readily washable and colorfast.

TEXTONE Panels have good resistance to dimensional change. (See Appendix for hygrometric and thermal coefficients.)

TEXTONE Gypsum Panels are applied vertically to the walls so that ends occur at floor and ceiling lines. The beveled edges form an attractive joint not requiring joint treatment. Panels are not practical as a ceiling finish, as end joints are difficult to conceal. They can be used with wood or steel studs in single- or double-layer application in new construction or over plaster or gypsum panel surfaces in remodeling; may also be applied to furring attached to masonry. Not recommended for use over foil-back panels in exterior walls. For additional information, fire-rated construction and technical data, see U.S.G. technical folder WB-1330.

Installation

When installing patterns other than one-color Pumice, place panels against wall, inverting alternate panels, and rearrange to obtain the best match in pattern and tone; there will be a slight variation from panel to panel. Number backs of panels for proper installation sequence. Panels used in the same area should be

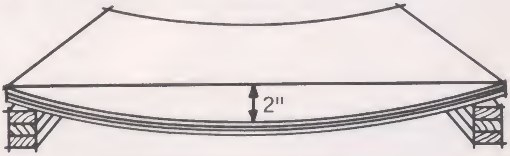
of the same lot number for best color match (lot numbers are imprinted on panel backs).

Apply panels vertically. Position less-than-full-width panels with cut edge at corner where the raw edge can be overlapped by the abutting panel or covered with a corner mould. Use USG Color-Matched Nails for nail-on application. Drive nails with plastic-headed hammer or rawhide mallet. Space 1⅜″ nails at least ⅜″ from ends and edges, 8″ o.c.

Cut TEXTONE Panels with a sharp knife. Cut through vinyl film into core. Snap board and cut back paper.

TEXTONE Mouldings in matching colors and patterns are available to finish edges and conceal fasteners in TEXTONE Gypsum Panel installations. Refer to Chapter 1 for description.

Prebowing—Where fasteners at the vertical joints are objectionable, panels may be prebowed, adhesively applied and fastened at top and bottom only. Prebow by stacking panels face up with ends resting on 2×4 lumber on edge or gypsum panel slutters and center of panel resting on floor. Allow to remain overnight or until panels show at least a 2″ permanent bow. During high humidity, it may be necessary to elevate ends as much as 8″ to achieve desired permanent bow (shown below).



Adhesives—Only water-based adhesives are recommended for use with TEXTONE Panels. Other adhesives may not be compatible and could result in delamination and discoloration of vinyl surface.

The following commercially available adhesives may be used for applying TEXTONE Panels in non-fire rated assemblies: **drywall stud adhesive** (meeting ASTM C557) for application to wood or steel studs; **laminating adhesive** for bonding panels to monolithic concrete, concrete block, wood and mineral-fiber sound deadening board, polystyrene and urethane rigid-foam insulation and most other wall surfaces; **contact adhesive** for laminating TEXTONE Panels to gypsum base layer panels. **Vinyl foam tape** may be used with adhesive for supplemental attachment (in lieu of prebowing or temporary shoring) until permanent adhesive attains ultimate strength.

A DURABOND Joint Compound or USG Ready-Mixed Joint Compound-All Purpose or Taping and mechanical fasteners are required for fire-rated construction (see previous description Double Layer Adhesive Application).

Adhesive Application to Wood or Steel Studs

Apply 8″-long strip of vinyl foam tape to face of each stud, positioned at midpoint of studs up to 8′ long, at third-points on studs up to 12′ long and quarter-points on studs over 12′. Where no mechanical fasterners are to be used at top or bottom of stud,

apply an 8″-long strip of tape. Apply a continuous ⅜″ bead of drywall stud adhesive to the entire face of studs between vinyl foam tape. Immediately apply TEXTONE Panels vertically and apply sufficient pressure to insure complete contact with both tape and adhesive.

Adhesive Application to Base Layer of Gypsum Panels
Apply liquid contact adhesive to back of TEXTONE Panels and face of base layer according to manufacturer's directions. Allow adhesive to air-dry, then bring panels in contact. Impact entire surface to assure complete contact.

Adhesive Application to Base Layer of Masonry, Gypsum Board, Wood or Mineral Fiber Board
For interior masonry walls and gypsum board, apply continuous strips of vinyl foam tape to entire width of TEXTONE Panel back at midpoint and ⅜″ from each end. Spread laminating adhesive over entire area of panels between tape using notched metal spreader with ¼″ x ¼″ notches spaced 2″ o.c. Position panel and immediately apply sufficient pressure to assure complete contact over entire surface. (Mechanical fasteners may be substituted for tape at ends of panels.)

For application of TEXTONE Gypsum Panels to wood or mineral board, pre-bow panels and apply laminating adhesive over entire back surface. Use mechanical fasteners at top and bottom of panel.

TEXTONE Mouldings

Aluminum and rigid vinyl trim and mouldings are available in solid and matching colors to finish TEXTONE Gypsum Panel installations. Refer to Chapter 1 for product description and colors available.

installation

General—Store mouldings at room temperature for 24 hr. before installation. Start installation from corner or door. Be sure that starting points are plumb and level. Fasten mouldings with flat-head wire nails, staples or drywall screws 12″ o.c. Fasten snap-on mouldings with nails or screws driven through holes in retainer. Use a fine-toothed hacksaw to cut mouldings. For mitering, use the same procedures as with wood moulding. Cut mouldings 1⁄16″ short for a loose fit to allow for thermal expansion; *never* force mouldings into place.

RP-2 and RPV-2 Inside Corner—Install first panel so that vertical edge aligns with framing. Apply moulding over first panel, fastening exposed flange to framing. Insert opposite panel into moulding.

RP-4 and RPV-4 End Cap—Align and fasten end cap to framing. Insert panel into moulding and apply panel to wall.

RP-5 and RPV-5 Snap-on Corner—Apply panels, then place retainer strip over joint and fasten with nails or screws through holes provided. Snap corner face over retainer strip.

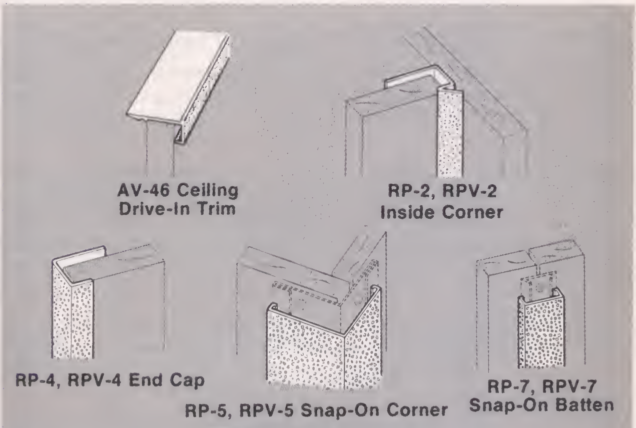
RP-7 and RPV-7 Snap-on Batten—Apply panels, then place retainer strip over joint and fasten with nails or screws through holes provided. Snap batten face over retainer strip.

PV-1 Rigid Vinyl Trim—Fasten trim to ceiling runner with nails or screws spaced 12″ o.c. Use 4d common nails for single-layer application over wood framing; $3/8$″ Type S Pan Head Screws for single-layer over steel framing. Insert panel in place.

AV-46 Ceiling Drive-in Trim—Use only with steel stud partitions. Install after panels are applied. Insert grooved flange between runner and ceiling; tap trim into place. (Not recommended where perimeter must be acoustically sealed.)

Painting—If mouldings other than TEXTONE Mouldings are used, they should be decorated prior to application over panels. Avoid applying masking tape to mouldings or predecorated panels when decorating.

Ivory RP-series mouldings *should* be used when painting is required. The following paints are recommended: TAL Latex Semi-Gloss Enamel, Latex Wall Paint or similar acrylic latex paint; or good quality alkyd enamel. Apply according to manufacturer's directions.



TEXTONE Mouldings

SHEETROCK Brand W/R panels application

SHEETROCK Brand W/R and W/R FIRECODE "C" Gypsum Panels are superior water-resistant bases for the adhesive application of ceramic tile. For use in new construction in high-moisture areas such as bathrooms, powder rooms, kitchens and utility rooms. They install quickly and easily to wood or steel framing or furring using standard attachment methods. Exposed edges and joints in areas to be tiled are treated with SHEETROCK Brand W/R

Compound. See Chapter 3 for application of SHEETROCK Brand W/R FIRECODE "C" Panels to meet fire ratings.

Where SHEETROCK Brand W/R panels are used in remodeling, old wall surfaces must be removed and W/R Panels applied to exposed studs as in new construction. Refer to Chapter 1 for other limitations.

Installation

Framing—Check alignment of framing. If necessary, fur out studs around shower receptor so that inside face of lip of fixture will be flush with gypsum panel face (see details).

Install appropriate blocking, headers, or supports for tub and other plumbing fixtures, and to receive soap dishes, grab bars, towel racks or similar items. SHEETROCK Brand W/R panels are designed for framing 16″ o.c. but not more than 24″ o.c. When framing is spaced more than 16″ o.c., or when ceramic tile over 5⁄16″ thick will be used, install suitable blocking between studs. Place blocking approx. 1″ above top of tub or receptor and at midpoint between base and ceiling. Blocking is not required on studs spaced 16″ o.c. or less. Vapor retarders *must not* be installed between SHEETROCK Brand W/R Panels and framing.

Receptors—Install receptors before panels are erected. Shower pans, or receptors, should have an upstanding lip or flange at least 1″ higher than the water dam or threshold at the entry to the shower.

Gypsum Panels—After tub, shower pan or receptor is installed, place temporary 1⁄4″ spacer strips around lip of fixture. Pre-cut panels to required sizes and make necessary cut-outs. Before installing panels, brush thinned SHEETROCK Brand W/R Compound over all cut or exposed panel edges at utility holes, joints and intersections.

Install panels perpendicular with paperbound edge abutting top of spacer strip. Fasten panels with nails 8″ o.c. max., or screws 12″ o.c. max. Where ceramic tile more than 5⁄16″ thick will be used, space nails 4″ o.c. max. and screws 8″ o.c. max.

For tile 5⁄16″ thick or less, panels may be installed with stud adhesive (meeting ASTM C557) to wood or steel framing. Apply 3⁄8″ bead to stud faces—two beads on studs where panels join. Do not apply adhesive to blocking where no fasteners will be used. Position panel and drive nails or screws at 16″ intervals around perimeter, 3⁄8″ from edges.

For double-layer applications, both face and base layer must consist of SHEETROCK Brand W/R Panels.

In areas to be tiled, treat all fastener heads with SHEETROCK Brand W/R Compound. Fill tapered edges in gypsum panel completely with SHEETROCK Brand W/R Compound, embed PERF-A-TAPE Reinforcement firmly, and wipe off excess compound. Immediately apply a second or skim coat over the taping coat, being careful not to crown the joint or to leave excess compound on panel as the compound is difficult to sand and to remove when dry. Apply SHEETROCK Brand W/R Compound and

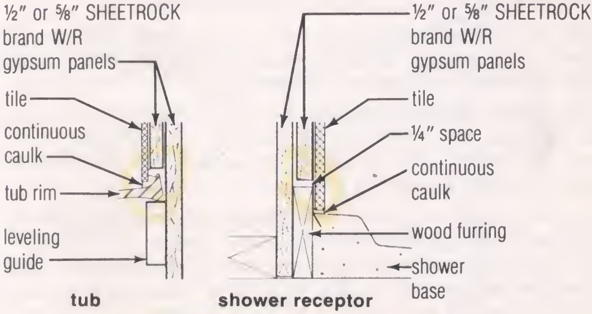
tape to all vertical angles in a similar manner. A third coat is not required prior to application of tile.

In areas not to be tiled, apply first coat to fastener heads with SHEETROCK Brand W/R Compound. Embed tape, finish face panel joints, internal angles, and fasteners with a U.S.G. Joint Compound to provide joint finishing for paint and wallpaper.

Fill and seal all openings around pipes, fittings and fixtures with a thinned-down coat of SHEETROCK Brand W/R Compound. To thin, add one-half pint of water per quart of compound to make a paint-like viscosity. With a one-inch brush, apply the thinned compound onto the raw gypsum panel core at cut-outs, and allow areas to dry thoroughly prior to application of tile. Before compound dries, wipe excess material from surface of gypsum panels. Remove spacer but do not seal gap at bottom edge of panels. Install tile down to top edge of shower floor of tub and overlapping lip or return of tub or receptor.

Note—Using an adhesive approved by the tile manufacturer, install tile down to top edge of shower floor or tub and overlapping lip or return of tub or receptor. Fill all tile joints with an unbroken application of grout. Apply caulking compound between tile and shower floor or tub.

Single-layer application



Double-layer application

Decoration—In untiled areas, prime with latex undercoater, finish with latex semi-gloss enamel or eggshell finish. For wallpaper application, prime panels and follow manufacturer's directions.

gypsum sheathing application

USG Gypsum Sheathing, with a noncombustible gypsum core, comes in two forms—**Regular,** ½″ thick with an asphalted core, and **Triple-Sealed,** 4⁄10″ thick with a plain core and treated ends—the latter the lowest-cost structural sheathing available for frame construction. Each provides a top-quality base for exterior finishes—wood, vinyl or metal siding, masonry veneer and stucco. Gypsum sheathing is widely used for garden apartments and light commercial construction as well as for homes.

Gypsum sheathing is *not* intended for use where the exposed surfacing material is to be adhesively applied, *with no* mechanical fasteners.

Refer to Chapter 1 for other limitations.

Installation

Regular Gypsum Sheathing—Apply 2×8-ft. tongue-and-groove-edge boards horizontally with tongue edge up. Use diagonal bracing where required for racking resistance. Use 11-ga. galvanized roofing nails 1½″ or 1¾″ long with 7⁄16″ heads. Space nails 8″ o.c. along each stud.

Apply 4×8-ft. or 9-ft. square-edge USG Sheathing vertically. Use same nails as for 2×8-ft. sheathing. With diagonal bracing, space nails 8″ o.c. Without bracing, install sheathing with bottom edge bearing on foundation or subfloor, space nails 4″ o.c. around perimeter and 8″ o.c. on intermediate framing members.

For staple application, use 16-ga. galvanized divergent-point staples, nom. ½″ wide, 1½″ long. Staple spacing and bracing requirements are same as for nail application. Drive staples parallel to long dimension of framing members, heads flush with sheathing surface but not breaking face paper.

Refer to U.S.G. folder GS-102 for complete data on USG Gypsum Sheathing. Refer to separate Curtain Wall Systems folder SA-805 for sheathing application to USG Steel Studs.

Triple-Sealed Gypsum Sheathing—Apply 4×8-ft. or 9-ft. sheathing vertically with bottom edge bearing on foundation or subfloor. Use same nails as for regular sheathing. With standard corner bracing, space nails 8″ o.c.

At external corners, when sheathing must provide racking resistance, apply drywall stud adhesive meeting ASTM C557 in ⅜″ beads to all studs and plates. Fasten sheathing to framing with nails spaced 12″ o.c. On balance of wall, apply sheathing without adhesive and nail 8″ o.c. For additional information, see U.S.G. data sheet GS-107.

exterior ceiling board application

USG Exterior Gypsum Ceiling Board embodies a specially treated gypsum core encased in chemically treated fiber paper. The result—an ideal surface material for sheltered exterior ceiling areas such as covered walkways and malls, large canopies, open porches, breezeways, carports and exterior soffits.

Weather and fire-resistant, ½″ or ⅝″ thick USG Exterior Gypsum Ceiling Board may be applied directly to wood framing or to cross-furring of wood or USG Metal Furring Channels attached to main supports.

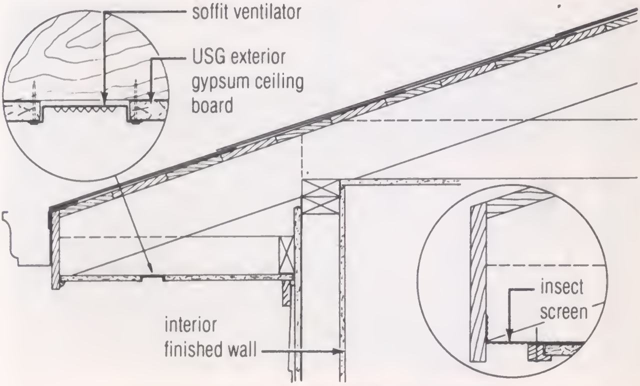
Special Conditions

Where frame spacing exceeds 16″ o.c. for ½″ board or 24″ o.c. for ⅝″ board, furring is required to provide support for gypsum board.

Wood Framing Requirements—1×4 wood furring may be used for screw application where support member spacing is 24″ o.c. max. Furring of 2″ nom. thickness should be used for nail application of board or where framing spacing is from 24″ to 48″ max. o.c.

Steel Framing Requirements—Installation of grillage should be the same as for Single-Layer Application—Steel Frame, previously described in this chapter.

Ventilation—Where the area above Ceiling Board opens to an attic space above habitable rooms, the space should be vented to the outside in accordance with HUD/FHA recommendations of one sq. ft. free vent area per 150 sq. ft. of attic area. Where Ceiling Board is applied directly to rafters or to roof-ceiling joists (as in flat-roof construction) that extend beyond habitable rooms, vents are required at each end of each rafter or joist space. The vents should be screened and be a minimum 2″ wide × full length between rafters (or joists). Vents should be attached through board to min. 1″×2″ backing strips installed prior



Application details

to board application. Vent openings should be framed and located within 6″ of outer edge of eave.

Weather Protection—At the perimeter and at vertical penetrations, the exposed core of panels must be covered with No. 401 Metal Trim or securely fastened mouldings.

In areas subject to freezing temperatures and other severe weather conditions, shingled roofs should be installed in accordance with good roofing practices.

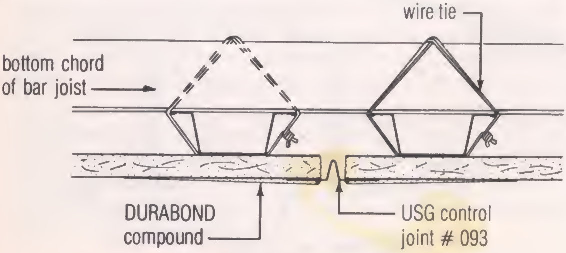
Fascia boards should extend at least ¼″ below the Ceiling Board or adjacent trim mouldings, whichever is lower to provide a drip edge.

Intersections—Where Ceiling Board expanse exceeds 4 ft., a space of at least ¼″ should be provided between edge of Exterior Ceiling Board and adjacent walls, beams, columns and fascia. This space may be screened or covered with moulding but must not be caulked.

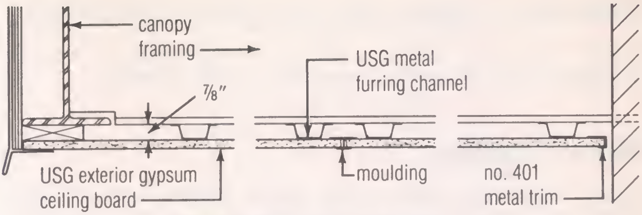
Exterior Ceiling Board application showing wall intersection (left), and control joint.

Control Joints—USG Exterior Gypsum Ceiling Board, like other building materials, is subject to structural movement, expansion and contraction due to changes in temperature and humidity.

Install a USG Control Joint No. 093 or a control joint consisting of two pieces of No. 401 Metal Trim back-to-back in Ceiling Board where expansion or control joints occur in the exterior wall or roof. Where aluminum H-mouldings are used, they will serve as control joints provided board is not tightly inserted.



Steel frame canopy (commercial)



Steel frame furred canopy

Long narrow areas should have control joints spaced no more than 30 ft. apart. Wings of "L", "U" and "T"-shaped areas should be separated with control joints. These joints usually are placed to intersect light fixtures, vents, etc. to relieve stress concentrations.

Fixtures—Provide backing or blocking for electrical boxes, vents and heavy fixtures. Cut board neatly and accurately to fit within 1/4″ of fixtures and vents. Cover openings with trim.

Installation

Apply Exterior Ceiling Board with long dimension across supports. For 1/2″ board, max. support spacing is 16″ o.c.; for 5/8″ board, 24″ o.c. max. Position end joints over supports. Use maximum practical lengths to minimize end joints. Allow 1/16″ to 1/8″ space between butted ends of board. Fasten board to supports with screws spaced 12″ o.c. or nails spaced 8″ o.c.

For steel framing, use 1″ Type S cadmium-plated screws. (Type S-12 for 20-ga. and thicker steel). For wood framing, use 1 1/4″ Type W Screws or 1 1/2″ galvanized box nails or 1 1/2″ aluminum nails. Treat fasteners and joints using a DURABOND Joint Compound as described in this chapter. If desired, panel joints may be concealed with batten strips or by installing panels with ends inserted into aluminum H-mouldings. After joint compound has dried, apply one coat oil-based primer-sealer and one coat exterior oil or latex paint to all exposed surfaces.

Clubhouse entrance canopy, faced with Exterior Ceiling Board.

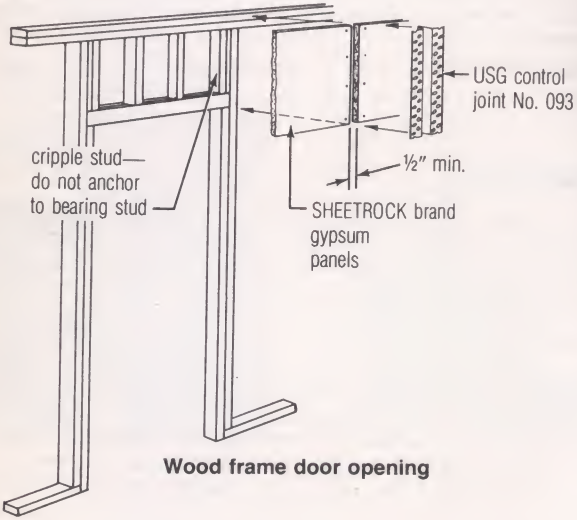
framing—door and window openings

Rough framing for most door and window openings is the same for gypsum panels and gypsum base veneer systems.

Wood Framing

Install additional cripple studs above header and ½″ from bearing studs where control joints are required. Do *not* anchor cripple stud to bearing stud, header or plate.

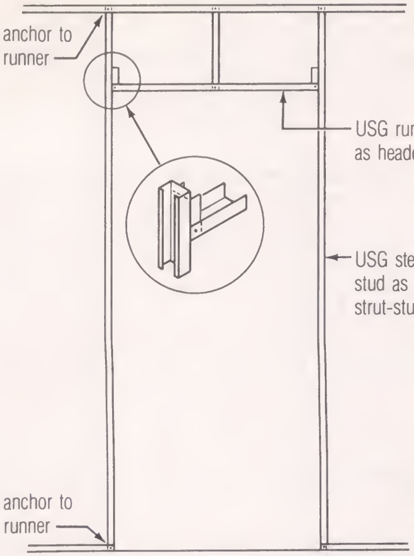
In long runs, treat window openings in same manner as shown for doors.



Wood frame door opening

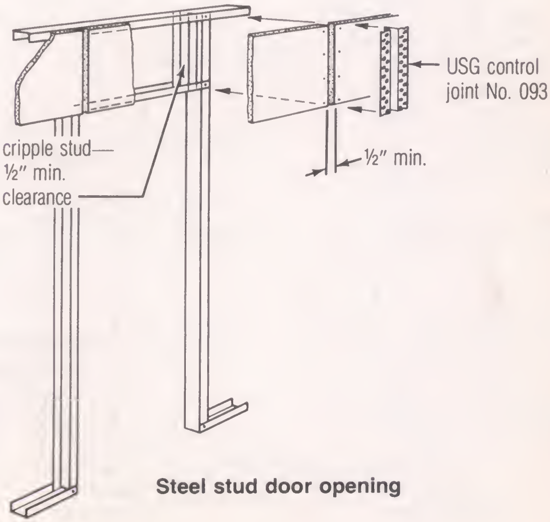
Steel Framing

Door and borrowed light openings should be rough-framed with steel studs and runners. Position floor-to-ceiling-height strut-studs vertically, adjacent to frames, and anchor securely to top and bottom runners with the USG Metal Lock Fastener or screws. Where heavy or oversize doors are used, install additional strut-stud at jambs. Fabricate sill and header sections from USG Steel Runners and install over less-than-ceiling-height door frames and above and below borrowed light frames. Fabricate from a section of runner cut-to-length approx. 6″ longer than rough opening. Slit flanges and bend web to allow flanges to overlap adjacent vertical strut-studs. Securely attach to strut-studs with USG Metal Lock Fasteners or screws. For frames with jamb anchor clips, fasten clips to strut-studs with two ⅜″ USG Type S-12 Pan Head Screws. Install cripple studs in the center above the door opening and above and below borrowed light openings spaced 24″ o.c. max.

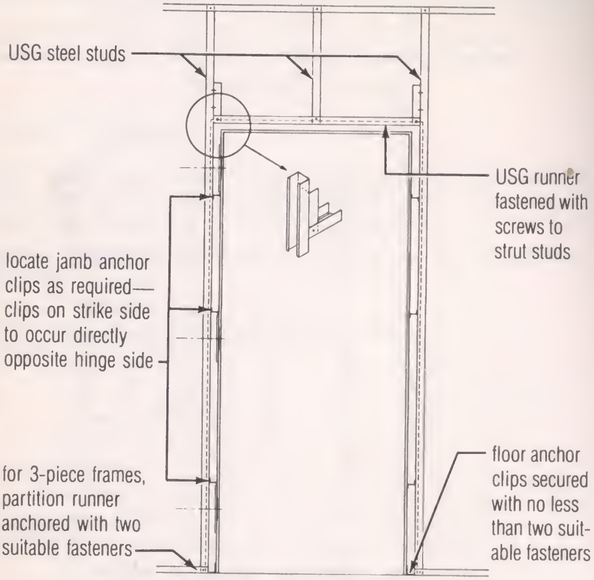


Door frame with steel runner as header

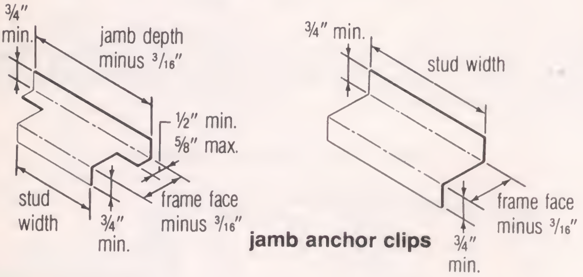
Where control joints in header boards are required, install cripple studs ½″ away from strut-studs but do not attach cripple to runners or strut-studs.



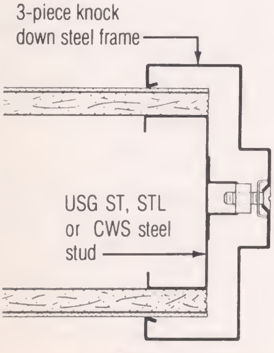
Steel stud door opening



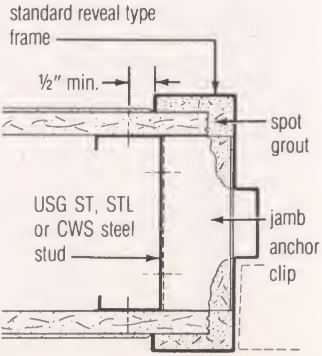
Frame for standard door



jamb anchor clips



jamb
standard door



jamb
standard door

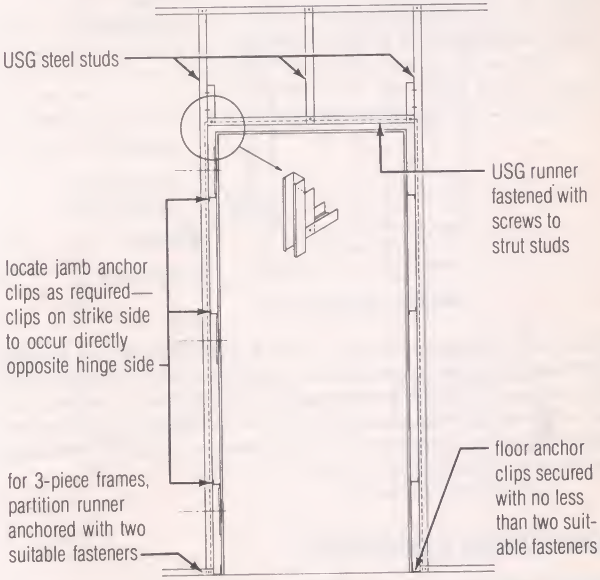
Note: 3-piece frames are recommended for drywall and veneer construction since these frames are installed *after* gypsum board is in place. One-piece frames, which must be installed before the gypsum board, are more difficult to use because the board must be inserted under the frame returns as it is installed.

Framing for Heavy and Oversize Doors

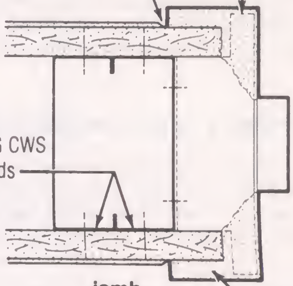
The steel framing method described above is suitable for standard doors up to 2′8″ wide, weighing not more than 100 lb. max., ST steel studs and runners may be used for framing the opening. For wider or heavier doors, the framing must be reinforced.

For solid-core doors and hollow-core doors 2′8″ to 4′0″ wide (200 lb. max.), rough framing should be CWS steel studs and runners. For heavy doors up to 4′0″ wide (300 lb. max.), two CWS studs should be used. For doors over 4′0″ wide, double doors and extra-heavy doors (over 300 lb.), framing should be specially designed to meet load conditions. Rough framing for all doors in fire-rated partitions should be CWS studs and runners.

For added door frame restraint, spot-grouting at the jamb anchor clip is recommended. Spot-grouting is required for solid-core doors and doors over 2′8″ wide. Apply DURABOND Joint Compound just before inserting board into frame; do not terminate gypsum panel against trim return.



Elevation
cross-section through frame wide and heavy doors

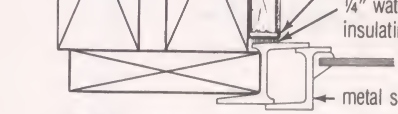


jamb
heavy doors 2′8″ to 4′0″

Metal Window Framing

In climates where extremes in summer or winter temperatures may result in condensation on metal frames, gypsum board (drywall and veneer) should be isolated from direct contact with the frame.

By placing metal trim (No. 200-B, No. 801-A and B and No. 400 for drywall assemblies—No. 701-A and B or 801-A and B for veneer assemblies) between the gypsum board and window frame, protection against moisture damage is provided.



Detail—window trim

Waterproof insulating tape, ¼″ thick and ½″ wide, or a waterproof acrylic caulk is required to separate metal sash and metal trim and will provide some measure of insulation between the two different metals. Direct contact of an aluminum frame and steel trim in the presence of condensation moisture may cause electrolytic deterioration of aluminum frame.

Door Frame Installation

The following general recommendations apply to one-piece and three-piece door frames and are basic considerations for satisfactory performance.

Rough framing and rough frame reinforcement for these frames should be installed as previously described.

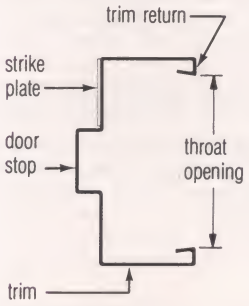
Installation—One-piece metal door (and borrowed light) frames used with gypsum panel and gypsum base partitions must be constructed and installed properly to prevent twisting or movement. Basic considerations for satisfactory performance are:

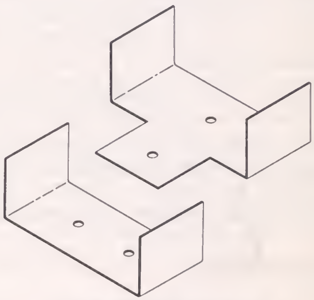
1. Frames must be securely anchored. If frames are free to twist upon impact, or trim returns are free to vibrate, movement of the frame will tend to pinch gypsum board face paper and crush core, resulting in unsightly cracks in the finish and loose frames.

2. Partition must fit securely in frame so that wall and frame work as a unit. Impact stresses on frame will then be dissipated over entire partition surface and local damage minimized.

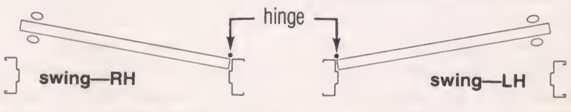
3. The frame must have a throat opening between trim returns that accurately fits the overall thickness of the partition. The face-layer panels should be enclosed by the trim and not butted against the trim return. This throat opening measurement is critical, as too large a tolerance between panels and trim return will cause door frame to twist and vibrate against the panels. Too small a tolerance will prevent the panels from fully entering frame opening; as a result, the door frame will not be held securely by the partition.

4. One-piece metal door (and borrowed light) frames should be formed from 18-ga. steel min., shop-primed. Floor anchor plates for door frames should be 16-ga. steel min., designed with two anchor holes to prevent rotation, and shop-welded to frame rabbets to dampen door impact vibrations. Floor anchorage should be by two power-driven anchors or equivalent per plate. Jamb anchor clips should be formed of 18-ga. steel min., fit tightly in jambs, and screw-attached to the stud. A min. three anchor clips per jamb is recommended with locations at approximate hinge points.





typical floor anchor clips



Detail—one-piece frame

5. To provide maximum rigidity of metal door frames, *spot-grouting* at the strike jamb-anchor clips is recommended after the stud is installed but before the gypsum boards are erected. A grouting (DURABOND Joint Compound, or RED TOP or STRUCTO-LITE Gypsum Plaster) should be applied just before the face layer is inserted to securely adhere the boards to the frame.

6. Door closers and bumpers are required on all doors where door weight (including attached hardware) exceeds 50 lb., or where door width exceeds 36″. These doors require spot-grouting at jamb anchor clips and added reinforcement at jamb.

7. When installing a 3-piece knock-down door frame, secure runner ends with two floor anchors and allow space in the rough framing for the adjustment shoes in the frame.

8. When ordering metal door frames, the factors to be considered include: gauge of frame; width and height of door; swing direction of door; type and thickness of door; stud size, and overall thickness of partition.

framing exterior doors

For data on exterior frames and doors, see Castlegate technical folders on Insulated Steel Doors.

concrete coatings

COVER COAT Drywall Compound

With ready-mixed COVER COAT Compound, drywall contractors are able to offer smooth or textured, white, ready-to-decorate surfaces on concrete ceilings and columns located above grade. Smooth application and excellent bonding strength make COVER COAT Compound ideal for filling small holes and crevices and for second and following covering applications with drywall methods and tools.

COVER COAT Compound should not be applied over moist surfaces or surfaces likely to become moist (by condensation or otherwise), on ceiling areas below grade, on surfaces which project outside the building, or on other areas which might be subject to moisture, freezing, efflorescence, pitting or popping, movement, or other abnormal condition.

application

1. For best results, apply COVER COAT Drywall Compound before interior partitions are erected. Use the compound at package consistency to minimize shrinkage. If a thinner material for roller application is desired, the compound may be thinned by adding clean water (up to 1 to 1½ gal. per 55.1 lb. or 1½ to 2 gal. per 61.7 lb. compound) and mixing to desired consistency using a potato masher or low-speed drill type mixer. If applicator

should inadvertently overthin, simply add additional compound to thicken and remix.

2. Protect COVER COAT Compound from freezing. During entire application, maintain temperature at or above 55°F. (13°C), and provide heat and ventilation when necessary.

3. All areas to be treated must be clean, dry and free from contaminants and all exposed metal protected with a rust-inhibitive primer. Grind off large projections such as form lines and fills and bring flush with concrete surface.

4. Fill large voids and aggregate pockets with a DURABOND Joint Compound.

5. Apply COVER COAT Compound over joints and ridges left by concrete forms with a flat finisher or knife. Fill in and/or level out small holes and lumps, ridges, lips, etc. with compound. Allow to dry.

6. Using two men, apply first coat of compound to entire surface area of ceiling, beam, or column with flat finisher, long nap roller or regular knife. Keep moving in one direction, making sure that each application overlaps the previous one. Follow application with wide rubber squeegee or pole drywall blade, 24″ or wider, to smooth out fresh application, leaving a minimum of ridges and imperfections. Apply USG No. 800 Corner Bead on angles and corners as required, embedding and covering both flanges with a smooth fill of COVER COAT Compound 3″ to 4″ wide. Allow to dry (under good drying conditions, 24 hr.).

7. Before second-coat application, sand and dust first coat. Apply second coat in manner described above or texture at this point if desired. Allow to dry. Sand to ultimate smoothness with fine sandpaper, if necessary. For texturing second coat, simply add water and/or sand. Use very fluid mix for fine texture, less fluid for coarse effects.

8. A very rough or uneven concrete surface may require three or more coats applied in the same manner.

9. COVER COAT Compound should be dry and dust-free if further decorating is desired. Seal with a good-quality primer-sealer before finish decoration is applied.

10. More detailed directions, spray application and special-use information are available on request. Ask for U.S.G. folder J-59.

Note: Check cracking may occur in excessively deep fills. For this reason successive coats are recommended for deep fills using a DURABOND Joint Compound for the first coat.

DURABOND Joint Compound

A DURABOND Compound is equally suitable for filling form offsets and voids left in interior concrete. As with COVER COAT, DURABOND Compound should not be applied over moist surfaces or surfaces subject to moisture, or any abnormal condition.

application

1. Grind off all projections on concrete surfaces.
2. Remove all dirt, grease and form oil from concrete surface.
3. Mix compound according to bag directions.
4. Apply to fill all offsets and voids in concrete.
5. After DURABOND has hardened (not necessarily dry), apply a skim coat of USG Ready-Mixed All Purpose or Topping Compound over entire surface.
6. When dry, sand surface as necessary.
7. Paint or decorate surface as desired.

special applications and constructions

Integral Plaster Chalkboards

Plaster chalkboards offer maximum freedom in design. There is no limiting sheet size as is the case with fabricated boards; therefore, entire walls can be utilized as chalkboards. Maintenance is accomplished as easily as with conventional fabricated chalkboards. (Requirements for control joints in chalkboard surfaces are the same as for other gypsum surfaces.)

chalkboard with steel stud-IMPERIAL partitions

Follow directions for system construction, Chapter 3. Locate floor and ceiling runners and position studs 16″ o.c. Attach ½″ IMPERIAL Gypsum Base using 1″ USG Type S Screws spaced 16″ o.c. When chalkboard area does not extend from floor to ceiling, use 701-A or 801-A Metal Trim to frame the ½″ IMPERIAL Base face layers that will be used as chalkboard. *(All chalkboard surfaces must have two layers of IMPERIAL Gypsum Base.)* Miter corners of the metal trim to form a neat joint. Attach chalkboard using 1⁵⁄₁₆″ Type S Screws, driven through IMPERIAL base layer into the studs.

Veneer Application: use one- or two-coat plaster for chalkboard surface. *With one-coat work, apply IMPERIAL Finish to 1⁄16″ to 3⁄32″ thickness. Cover entire area with a tight, thin coat, then double back to full thickness. After surface has become firm, final-trowel to a smooth surface, using water sparingly.*

For two-coat application, apply IMPERIAL Basecoat to 1⁄16″ to 3⁄32″ thickness as described for single-coat application. Allow basecoat to set and partially dry; then apply IMPERIAL Finish or STRUCTO-GAUGE-lime smooth-trowel finish plaster. Leave surface very hard and polished.

Paint chalkboard, when dry, with one coat primer-sealer and two coats chalkboard paint.

Install chalktrough with USG 1⅕16″ Type S Screws, driven through the two layers of IMPERIAL Gypsum Base and into the *steel studs.*

Vapor Retarders

Foil-Back SHEETROCK Brand Panels when applied with their foil surface next to exterior framing provide an effective vapor retarder that helps prevent interior moisture from penetrating into stud and joist spaces. Vinyl wall coverings are not recommended for walls containing foil-back panels.

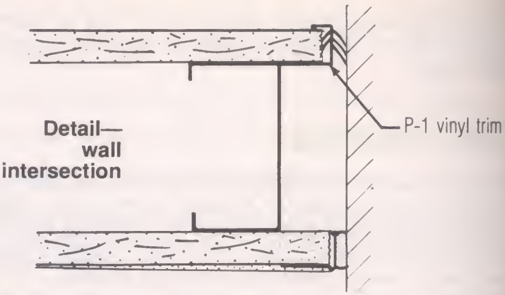
This system helps to maintain comfortable room humidity year 'round. Generally, during cold weather, a 10% increase in indoor relative humidity allows a 1°F. lower temperature with no decrease in comfort.

Foil backing is not recommended in air-conditioned buildings located in climates having sustained high outside temperature and humidity. Under these conditions, a qualified mechanical engineer should determine vapor retarder location.

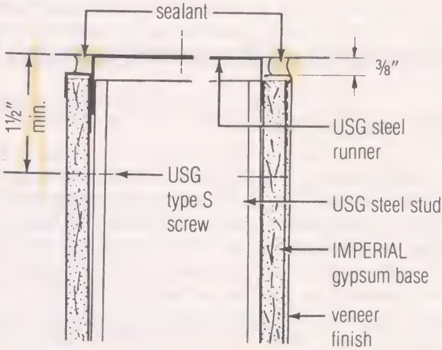
Perimeter Isolation

Perimeter relief should be provided for gypsum construction surfaces where (a) partition or furring abuts a structural element (except floor) or dissimilar wall or ceiling; (b) ceiling abuts a structural element, dissimilar partition or other vertical penetration; and (c) ceiling dimensions exceed 30 ft. in either direction. Isolation is important to reduce potential cracking in partitions, ceilings, wall, column, and beam furring. Generally, methods for isolating surfaces are detailed and specified according to the job. The typical intersection application described below may be adapted as required.

Perimeter relief at columns reduces possibility of cracking.

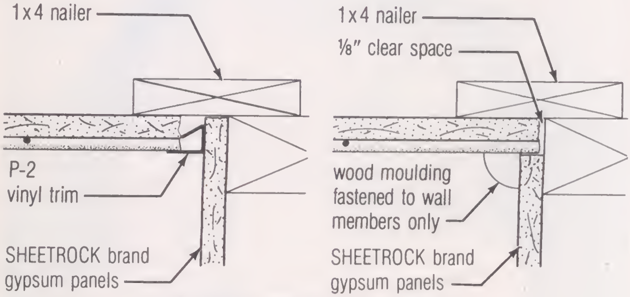


Gypsum Board Edge Treatment—Where boards intersect dissimilar materials or structural elements, appropriate trim should be applied to the face-layer perimeter, and sealant applied to close the gap. P-1 Vinyl Trim may be used without sealant or joint treatment.



Partition-structural ceiling

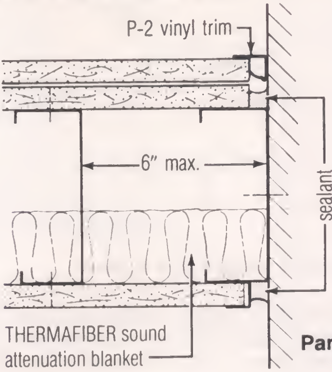
Partition-Structural Ceiling—Attach steel runner to structural ceiling to position partition. Cut steel stud 3/8″ less than floor-to-ceiling-height. Attach gypsum board to stud at least 1½″ down from ceiling. Allow 3/8″ min. clearance atop gypsum boards; finish as required.



Partition-radiant heat ceiling

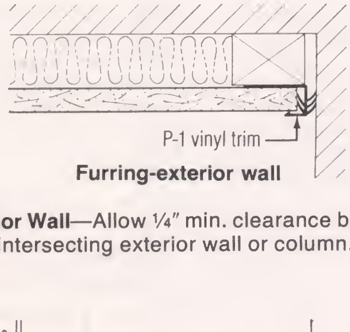
Partition-Radiant Heat Ceiling—Allow at least 1/8″ clear space between radiant-heated ceilings and walls or partition framing.

Finish ceiling angle with P-2 Vinyl Trim or wood moulding fastened to wall members only.



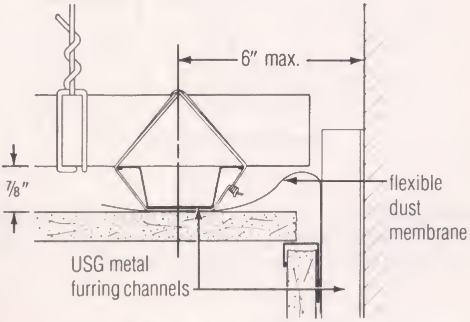
Partition-exterior wall

Partition-Exterior Wall—Attach steel stud to exterior wall to position partition. Attach gypsum board only to second steel stud erected vertically at max. 6″ from wall. Allow at least ⅜″ clearance between partition panel and wall. Caulk as required.



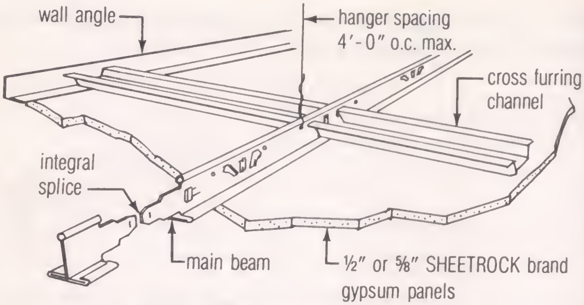
Furring-exterior wall

Furring-Exterior Wall—Allow ¼″ min. clearance between acoustical trim and intersecting exterior wall or column. Apply sealant as required.



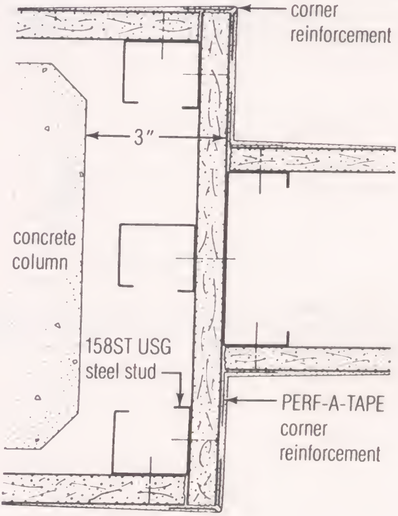
Ceiling-exterior wall

Ceiling-Exterior Wall—On suspended or furred ceilings, locate supports for gypsum board within 6″ of abutting surfaces but do not allow main runner or furring channels to be let into or come into contact with abutting masonry walls.



USG direct suspension system

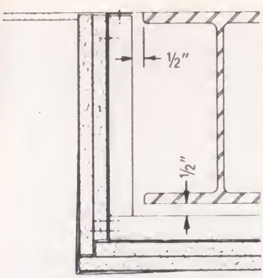
For the USG direct suspension system, attach gypsum panels to wall angles at perimeter. Locate cross furring channels within 6″ of walls without wall angles and within 8″ of panel end joints.



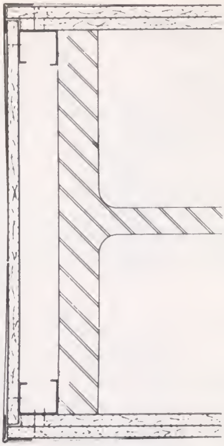
Partition-column

Partition-Column—Fur gypsum board away from concrete column using vertical steel studs. Attach stud in intersecting partition to stud within free-standing furring.

Beam and Column Fire Protection—Allow ½″ min. clearance between steel beam flanges and fire-resistive gypsum construction, unless otherwise specified for specific designs (see test report).



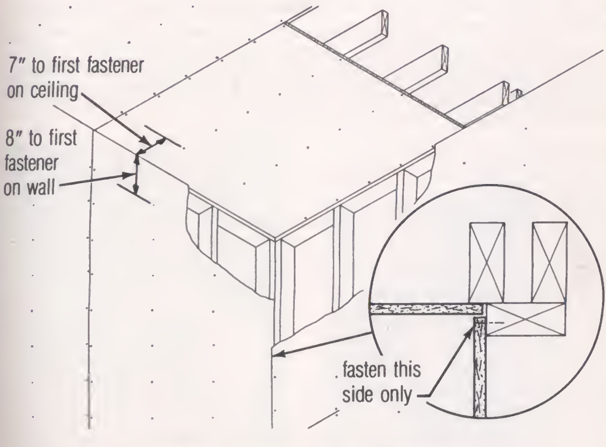
Beam fireproofing



Column fireproofing

Floating Interior Angle Application

The floating interior angle method of applying gypsum board effectively reduces angle cracking and nail pops resulting from stresses at intersections of walls and ceilings. Fasteners are eliminated on at least one surface at all interior angles, both where walls and ceilings meet and where sidewalls intersect. Follow standard framing practices for corner fastening. Conventional framing and ordinary wood back-up or blocking must be provided where needed at vertical and horizontal interior angles. Apply gypsum board to ceilings first.



Detail—floating interior angle

ceilings

Use conventional single nail or screw application. Apply the first nails or screws approx. 7″ from the wall and at each joist. Use conventional fastening in the remainder of the ceiling area.

sidewalls

Apply gypsum board on walls so that its uppermost edge (or end) is in firm contact with and provides support to the perimeter of the board already installed on the ceiling. Apply the first nails or screws approx. 8″ below the ceiling at each stud. At vertical angles omit corner fasteners for the first board applied at the angle. This panel edge will be overlapped and held in place by the edge of the abutting board. Nail or screw-attach the overlapping board in the conventional manner. Use conventional fastening for remainder of sidewall area.

double nailing

When double nailing is used with a floating interior angle, follow above spacing on first nail from intersection and use double nailing in rest of area. Conventional framing and ordinary wood back-up or blocking at vertical internal angles must be provided.

Mineral Fiber Blanket Application

Many U.S.G. drywall and veneer partitions have been developed to meet the demand for increased privacy between units in residential and commercial construction. Designed for wood stud, steel stud or laminated gypsum board construction, these assemblies offer highly efficient sound-control properties, yet are more economical than other partitions offering equal sound isolation. These improved sound-isolation properties and ratings are obtained by using THERMAFIBER Sound Attenuation Blankets and decoupling the partition faces (decoupling is achieved with resilient application or with double rows of studs on separate plates). General application procedures for these products follow. See Chapter 1 for product descriptions, SA-100 Construction Selector for sound ratings.

Water-based texturing materials applied to ceilings should be completely dry before insulation and vapor retarder are installed. Under most conditions, drying takes several days; i.e., 10% r.h. and 90°F. conditions require 1.5 days; 90% r.h. and 90°F conditions, 10.5 days; 30% r.h. and 60°F. conditions, 5.3 days. Refer to Texture Finish Application in this chapter for complete drying time table.

installation

Install blankets to completely fill height of stud cavity and with the vapor retarder facing warm side of wall. If necessary to tightly fill height, cut stock-length blankets with a serrated knife for insertion in the void. Tightly butt ends and sides of blankets

Friction-fitting of THERMAFIBER M-S Blankets in steel-stud exterior furring and curtain wall assemblies

within a cavity. Cut small pieces of THERMAFIBER Blankets for narrow stud spaces next to door openings or at partition intersections. Fit blankets carefully behind electrical outlets, bracing, fixture attachments, medicine cabinets, etc.

In ceilings, insulation should be carefully fitted around recessed lighting fixtures. Covering fixtures with insulation causes heat to build-up which could possibly result in fire.

Insulating Blankets to Wood Studs—Using a power-driven or hand stapling gun, attach paper flanges to sides of studs (shown, right) and at plates with staples having a ½″ leg and spaced 6″

Staple to sides of studs . . .

For tight board attachment

o.c. Do not attach blanket flanges to stud faces to achieve a continuous vapor retarder. This attachment prevents tight contact between board and framing and can result in loose board and fastener defects; also prevents adhesive attachment of board. Where a vapor retarder is required, install foil-back gypsum board.

Insulating Blankets to Gypsum Board—In steel stud and laminated gypsum board partitions, attach blanket to back side of board using staples applied with pistol-type hand stapler. For 3″ thick blankets use staples with a 7/8″ leg. Place staples at least 2″ in from edges, at each corner and along vertical edges spaced at max. 24″ o.c.

Sound Attenuation Blankets—Install blankets in stud cavities of sound-rated partitions. Friction fit securely between studs. Butt ends of blankets closely together and fill all voids.

FOAMULAR Polystyrene Insulation Application

Energy-saving systems offering the superior thermal and water-resistant properties of FOAMULAR Insulation are available to meet building requirements. These performance-engineered assemblies combine FOAMULAR Insulation, as sheathing, with other conventional materials to form 1-hour fire-rated, load-bearing walls with steel or wood framing. Application in these systems is shown below. Application using FOAMULAR Panels with Z-Furring Channels as low-cost, insulating furring for masonry and concrete walls was described earlier in this chapter. Application as insulation in masonry cavity walls, around foundations and beneath flat concrete slab is found in FOAMULAR Insulation folder SA-710.

installation

Wood Studs—Sheathing Application—Apply 2-ft. wide insulation horizontally with tongue edge up, or 4-ft. wide insulation vertically to outside of braced framing. Fasten insulation with 7/16″ crown staples spaced 8″ o.c., 3/4″ crown staples 12″ o.c. or 1″ diam. head nails spaced 24″ o.c. Use fastener length of 1½″ for 1″ thick insulation, 2″ for 1½″ insulation and 2½″ for 2″ thick insulation. Cover all framing with insulation panels and fit joints tightly.

Steel Studs—Sheathing Application—Apply 2-ft. wide insulation horizontally with tongue edge up, or 4-ft. wide insulation vertically. Fasten panels to studs with USG Type S-12 Wafer Head Insulation Screws spaced max. 12″ o.c. Use 1½″ length for 1″ thick insulation, 2″ length for 1½″ insulation, 2½″ length for 2″ insulation. At wall perimeter and terminations, install screws 8″ o.c. For fire-rated construction, apply 2-ft. wide FOAMULAR Insulation horizontally with tongue edge up over gypsum sheathing. Fasten 1″ panels to studs with 2″ Type S-12 Wafer

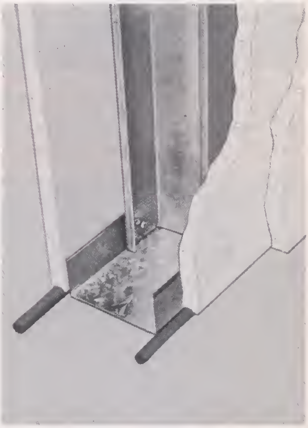
Wood-frame sheathing

Steel-frame sheathing

Head Insulation Screws spaced 12″ o.c. Cover all gypsum sheathing with panels and fit joints tightly. For 25- to 22-ga. steel studs in non-fire rated applications, use Type R; for 20- to 14-ga. steel studs, use Type S-12 Wafer Head Screws.

Sealant Application (Caulking)

If a gypsum board partition is to effectively reduce the transmission of sound, it must be airtight at all points. Perimeters must be sealed with acoustical sealant (a caulking material that



Proper caulking of outlet box (left), and double-layer partition.

remains resilient and will not shrink or crack), as must penetrations for electrical outlets, medicine cabinets, plumbing, heating and air-conditioning ducts, telephone and intercom hookups and television antenna outlets.

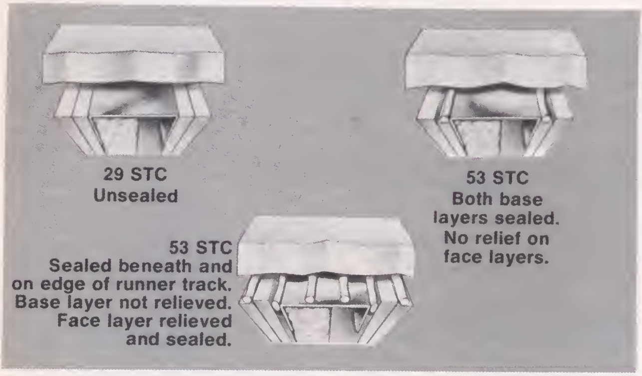
Sound-control sealing is so important that it *must* be covered in the specifications, understood by the workmen of *all related trades,* supervised by the foreman, and inspected carefully during construction. Sealing is not only important but also has proven to be the least expensive way to effectively seal the assembly to prevent sound leaks.

All references herein to "caulk" or "caulking" indicate use of USG Acoustical Sealant.

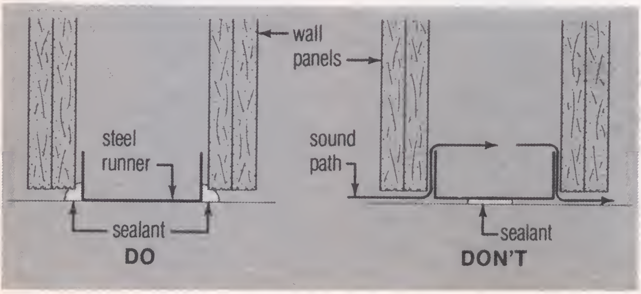
U.S.G. Research tests demonstrate that reliability of the perimeter seal is increased if perimeter relief does not exceed 1/8". When such a gap, around the base-layer perimeter, is caulked with a 1/4" bead of sealant, installation of face panels compresses the sealant into firm contact with all adjacent surfaces to form a permanent airtight seal.

The assemblies tested consisted of 2½" USG Steel Studs 24" o.c., double-layer ½" SHEETROCK Brand Panels each side; 1½" THERMAFIBER Sound Attenuation Blankets between studs.

Results of sealant conditions are shown below:



To be effective, sealant must be properly placed—placement is as important as the amount used. The following drawings show correct and incorrect applications.



installation

Partition Perimeter—Cut gypsum boards for loose fit around partition perimeter. Leave a groove no more than ⅛″ wide. Apply a ¼″ min. round bead of sealant to each side of runners, including those used at partition intersections with dissimilar wall construction. Immediately install boards, squeezing sealant into firm contact with adjacent surfaces. Fasten boards in normal manner. Gypsum panels may have joint treatment applied in normal manner over sealed joints, and gypsum base may be finished normally with veneer plaster. Or, panels may be finished with base or trim as desired.

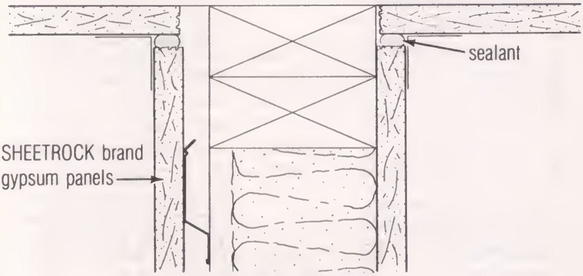
For caulking application with metal trim over edge of boards where boards intersect dissimilar materials or cracking due to structural movement is anticipated, refer to Perimeter Isolation described in this chapter.

Control Joints—Apply sealant beneath control joint to reduce path for sound transmission through joint.

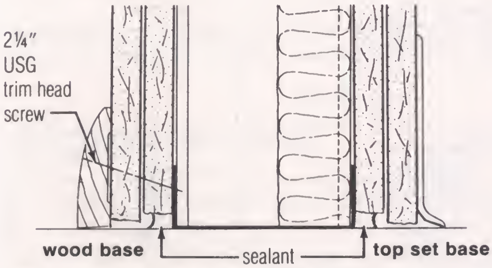
Partition Intersections—Seal intersections with sound-isolating partitions that are extended to reduce sound flanking paths.

Openings—Apply sealant around all cutouts such as at electrical boxes, plumbing, medicine cabinets, heating ducts and cold-air returns to seal the opening. Caulk sides and backs of electrical boxes to seal them.

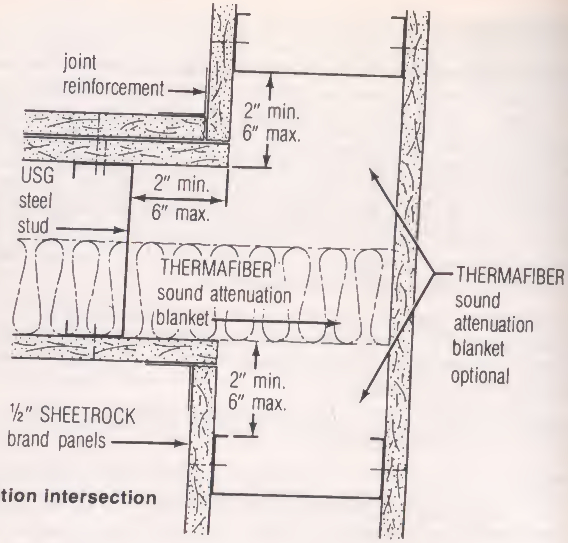
Details—use of sealant



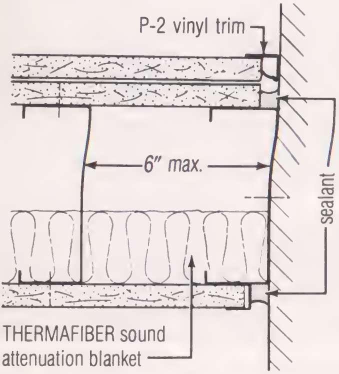
Ceiling attachment



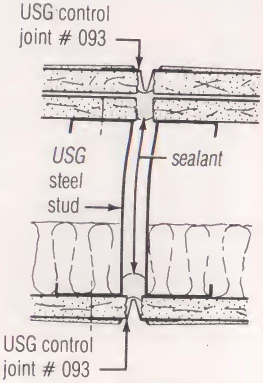
Floor attachment



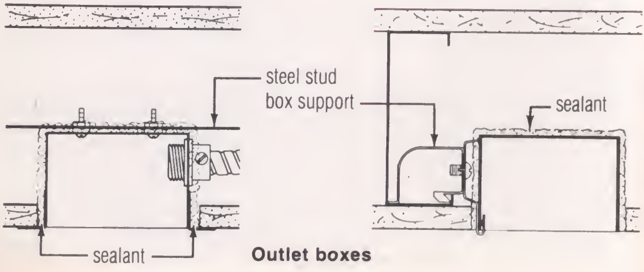
Partition intersection



Partition-wall intersection



Partition control joint



Outlet boxes

Fixture Installation

electrical fixtures

After electrical services have been roughed in and before gypsum board is installed, cut necessary openings in base and face layers of board to accept switches, outlet and fixture boxes, etc. Cut out opening with a keyhole saw or with specially designed cutting tools which produce die-cut openings. (See Tools and Equipment, Chapter 8.)

On TEXTONE Vinyl-Faced Panels, holes made with special outlet cutter should be cut from back of panel to avoid loosening vinyl around cut. Erect panel in the usual manner.

Sealant—Where the partition is used as a sound barrier, apply USG Acoustical Sealant around all boxes to seal the cutout. See typical sealant application, earlier in this chapter. Electrical boxes having a drywall ring or device cover for use as a stop in caulking are recommended.

fixture attachment

U.S.G. gypsum board partitions provide suitable anchorage for most types of fixtures normally found in residential and commercial construction. To insure satisfactory job performance it is important to have an understanding of particular fixture attachment so that sound-control characteristics will be retained and attachment will be within the allowable load-carrying capacity of the assembly.

In wood-frame construction, fixtures are usually attached directly to the framing or to blocking or supports attached to the framing. Blocking or supports should be provided for plumbing fixtures, towel racks, grab bars and similar items. Single or double-layer gypsum boards are not designed to support loads imposed by these items without additional support to carry the main part of the load.

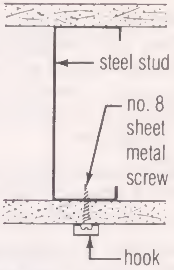
The attachment of fixtures to sound-barrier partitions may impair the sound-control characteristics. Only lightweight fixtures should be attached to resilient wall surfaces constructed with the RC-1 Resilient Channel unless special framing is provided (see Cabinet Attachment System, following). Refrain from attaching fixtures to party walls so as to provide a direct flow path for sound. Gypsum boards used in the ceiling are not designed to support light fixtures or troffers, air vents or other equipment. Separate supports must be provided.

fixture attachment types

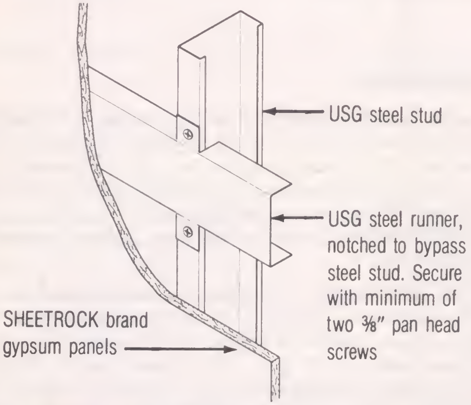
Loading capacities of various fasteners and fixture attachments used with U.S.G. gypsum board partitions appear in load table at end of this section. Fasteners and methods follows:

No. 8 Sheet Metal Screw—Driven into 25-ga. min. sheet metal plate or strip, laminated between face board and base board in

laminated gypsum partitions. Also may be driven through gypsum board into a USG Steel Stud. Ideal for pre-planned light fixture attachment.

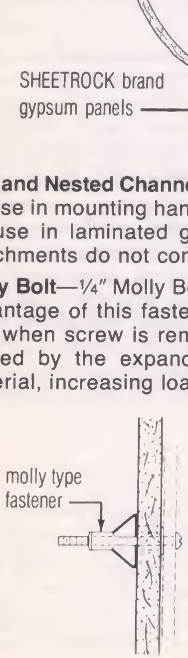


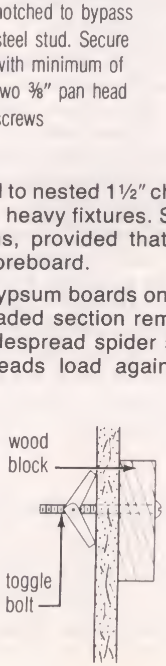
Continuous Horizontal Bracing—Back-up for fixture attachment is provided with notched runner attached to steel studs with two ⅜″ pan head screws.



Bolt and Nested Channels—Bolt welded to nested 1½″ channels for use in mounting hanger brackets for heavy fixtures. Suitable for use in laminated gypsum partitions, provided that fixture attachments do not contact opposite coreboard.

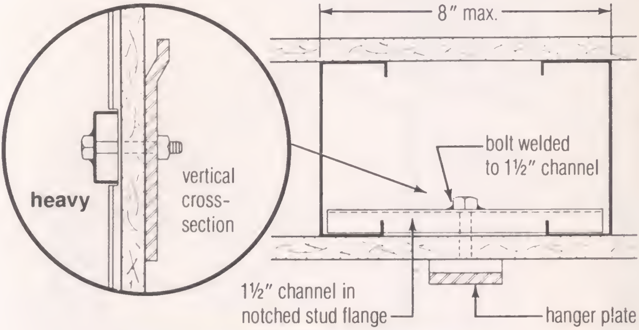
Molly Bolt—¼″ Molly Bolt installed in gypsum boards only. One advantage of this fastener is that threaded section remains in wall when screw is removed. Also, widespread spider support formed by the expanded anchor spreads load against wall material, increasing load capacity.





Toggle Bolt—¼″ Toggle Bolt installed in gypsum board only. One disadvantage of toggle bolt is that when bolt is removed, wing fastener on back will fall down into hollow wall. Another disadvantage is that a large hole is required to allow wings to pass through wall facings.

Bolt and 1½″ Channel—Bolt welded to single 1½″ channel and inserted in notches cut in steel stud for use in mounting hanger brackets for heavy fixtures. Suitable for use in U.S.G. gypsum board partitions with 3⅝″ steel studs.



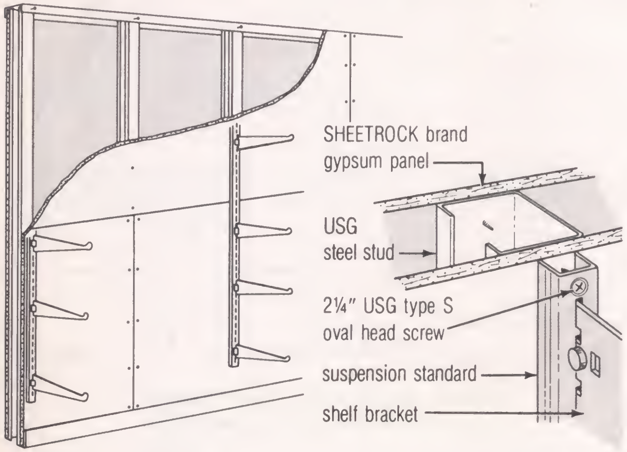
Fixture Attachment Load Data— Drywall and Veneer Construction

fastener type	size in	size mm	substrate	allowable withdrawal resistance lbf	allowable withdrawal resistance N(1)	allowable shear resistance lbf	allowable shear resistance N(1)
Molly or Toggle Bolt	⅛ ³⁄₁₆ ¼	3.18 4.76 6.35	½″ gypsum board	20 30 40	89 133 178	40 50 60	178 222 267
	⅛ ³⁄₁₆ ¼	3.18 4.76 6.35	½″ gypsum board and ST steel stud	70 80 155	311 356 689	100 125 175	445 556 778
no. 8 sheet metal screw USG Type S bugle head screw			½″ gypsum board & ST steel stud or 25-ga. steel insert	50 60	222 267	80 100	356 445
USG type S-12 bugle head screw			½″ gypsum board & CWS steel stud or 20-ga. steel insert	85	378	135	600
USG ⅜″ type S pan head screw			25-ga. steel to 25-ga. steel	70	311	120	534
Bolt welded to 20-ga. steel plate	³⁄₁₆	4.76	½″ gypsum board, plate and steel stud	175	778	200	890
	¼	6.35	½″ gypsum board, plate and steel stud	200	890	250	1112
Plumber's Bracket bolted to 1½″ channel	¼	6.35	(see drawing)	200	890	250	1112

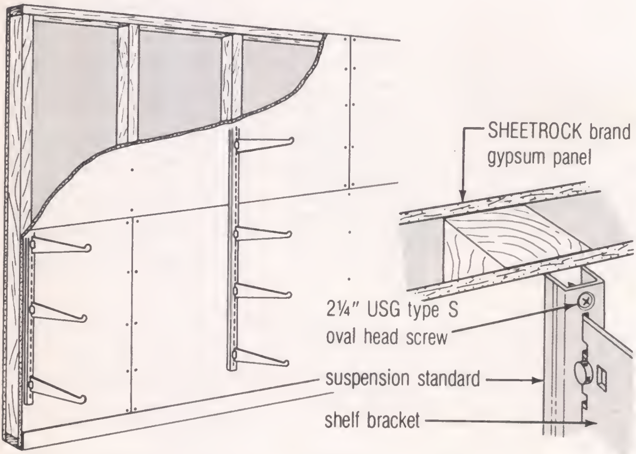
(1) Newton.

USG Shelf-Wall Systems—Provide load-carrying walls for shelving in stores, offices, schools and other applications. Incorporate simple, quickly erected, steel or wood stud components with Garcy shelf brackets, standards and accessories.

In the steel-framed assembly (below), 3⅝" USG Steel Studs spaced 24" o.c. are secured to floor and ceiling runners and faced with either single or double-layer gypsum board.

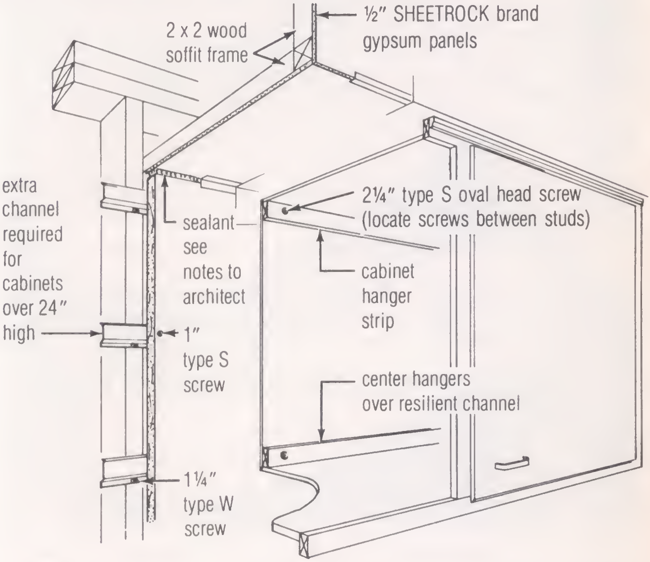


Slotted standards are screw-attached to studs or steel reinforcing inserted between board layers. In the wood-framed assembly (shown below), slotted standards are screw-attached to the studs with 2¼" Type S Oval Head Screws.



The partition is load-carrying, but with steel studs, is *not* structurally load-bearing. Limiting height is 16 ft.

Cabinet Attachment Method—Detailed below, allows kitchen, bathroom and other cabinets and fixtures (except lavatories and wall-mounted toilets) of moderate weight, and "Hollywood" style headboards on party walls using RC-1 Resilient Channel without reducing the sound rating. Recommended only for residential and light commercial wood-frame construction. Suitable for loads including cabinet weight of 67½ lb. for studs spaced 16" o.c. and 40 lb. for studs 24" o.c. Loads are max. per lin. ft. of RC-1 Channel installed for cabinet attachment.



In this system, ⅝" gypsum board is installed with long dimension parallel to channels and fastened with 1" Type S Screws spaced 12" o.c. along channels. Cabinets are attached to channels with 2¼" Type S Screws spaced 12" o.c. and located between studs. Screws must be driven between studs. Screws which penetrate the stud cause a significant loss in the partition's sound rating.

Curved Surfaces and Arches

SHEETROCK Brand Panels and IMPERIAL Gypsum Base can be formed to almost any cylindrically curved surface. To apply gypsum board, place a stop at one end of the curve and gently and gradually push on other end of panels, forcing center against framing until curve is complete.

By moistening the face and back paper thoroughly prior to application, and replacing in the stack for at least one hour, the board may be bent to still shorter radii. When the board dries thoroughly, it will regain its original hardness.

Effective use of gypsum board for curved wall surface.

To prevent flat areas between framing, space studs or furring closer together than normal. The shorter the radii of the bend, the closer the framing spacing should be.

Minimum Bending Radii of Dry Gypsum Board

thickness		length		width	
in	mm	ft	m	ft	m
½	12.7	20(1)	6.1	—	—
⅜	9.5	7½	2.3	25	7.6
¼	6.4	5	1.5	15	4.6

(1) Bending two ¼″ pieces successively permits radii shown for ¼″ gypsum board.

Arches of any radii are easily faced with gypsum panels or base and finished with U.S.G. joint system, or veneer finish. Score or cut through back paper of panels at 1″ intervals to make them

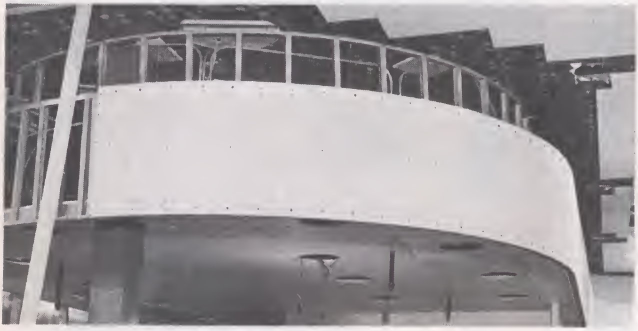
Curved panel sections form housing for lighting fixture.

Curved stairwell, faced with drywall, forms attractive design element in new shopping mall (above). Radius of curved gypsum board, joints treated, is shown in construction view below.

flexible. The board should previously have been cut to desired width and length of arch.

After board has been applied to arch framing with nails or screws, apply tape reinforcement (PERF-A-TAPE for panels or

IMPERIAL for base). Crease tape along center. Make scissor cuts half-way across tape and ¾″ apart to make tape flexible. Apply uncut half to curved surface, and fold cut half of tape onto wall surface. Finish as appropriate for drywall or veneer construction.



Construction and finished views of curved facade in store.

Soffits

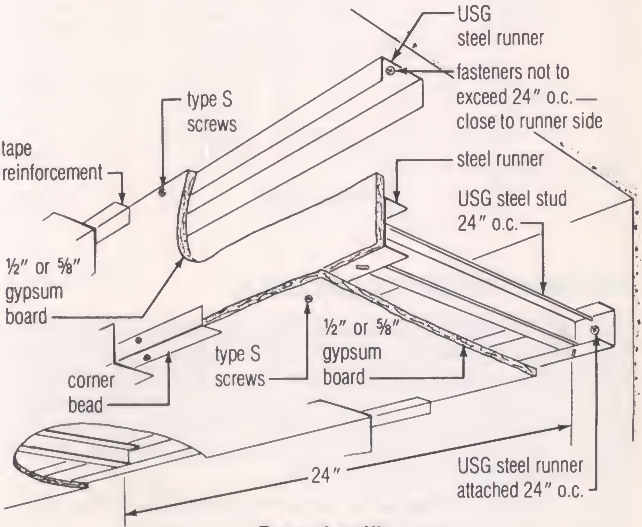
Gypsum board soffits provide a lightweight, fast and economical method of filling over cabinets or lockers and of housing overhead ducts, pipes or conduits. They are made with wood framing or with steel stud and runner supports, faced with screw-attached gypsum board. Braced soffits up to 24″ deep are constructed without supplementary vertical studs. Select components for the soffit size desired from table following. Unbraced soffits without horizontal studs are suitable for soffits up to 24″×24″. To retain fire protection, partitions and ceilings are finished with gypsum board before soffits are installed.

installation

Braced Soffit—Attach USG Steel Runners to ceiling and sidewall as illustrated in this chapter, placing fasteners close to

Drywall soffit provides lighting for exhibits below.

outside flange of runner. On stud walls, space fasteners to engage stud. Fasten vertical gypsum face board to web of face corner runner and flange of ceiling runner with Type S Screws spaced 12″ o.c. Place screws in face corner runner at least 1″ from edge of board. Insert USG Steel Studs between face corner runner and sidewall runner and attach alternate studs to runners with USG Metal Lock Fastener or screws. Attach bottom face board to studs and runners with Type S Screws spaced 12″ o.c. Attach corner bead and finish.



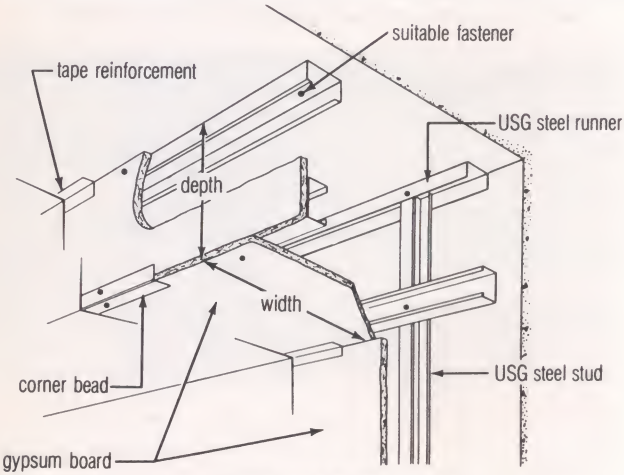
Braced soffit

Braced Soffit Design—Maximum Dimensions(1)

gypsum board thickness(2)		steel stud size		maximum vertical(3)		max. horizontal for max. vertical shown	
in	mm	in	mm	in	mm	in	mm
½	12.7	1⅝	41.3	60	1525	48	1220
½	12.7	2½, 3⅝	63.5, 92.1	72	1830	36	915
⅝	15.9	1⅝	41.3	60	1525	30	760
⅝	15.9	2½, 3⅝	63.5, 92.1	72	1830	18	455

(1) The construction is not designed to support loads other than its own dead weight.
(2) Double-layer applications and ⅜" board are not recommended for this construction.
(3) Widths shown are based on construction having *no* supplemental vertical studs. To exceed widths shown, vertical studs must be used.

Unbraced Soffit—Attach USG Steel Studs to ceiling and sidewall, placing fasteners to engage wall and ceiling framing. Cut gypsum board to soffit depth and attach a soffit-length stud with Type S Screws spaced 12″ o.c. Attach this preassembled unit to ceiling stud flange with screws spaced 12″ o.c. Attach bottom panel with Type S Screws spaced 12″ o.c. Attach corner bead and finish.



unbraced soffit

texture finish application

Textured finishes for gypsum board surfaces are accepted for their decorative beauty and ability to obscure minor surface imperfections with economical spray application. U.S.G. offers a full line of products to create fine, medium or coarse textures, sand or simulated acoustical finishes. Interesting wall patterns can be created with stipple brushes, pattern devices, rollers, floats, trowels and finishing knives.

Note: Textured surfaces also can be created with veneer finishes. See veneer application section in this chapter.

general limitations

1. Not recommended below grade or in high-humidity areas.

2. Heavy, water-based texturing materials may cause sag in gypsum panel ceilings under the following adverse conditions: high humidity, improper ventilation, panels applied parallel to framing and panels having insufficient thickness to span the distance between framing. The following table gives max. framing spacing for panels that are to be covered with water-based texturing materials.

Frame Spacing—Textured Gypsum Panel Ceilings

board thickness		application method (long edge relative to frame)	max. framing spacing o.c.	
in	mm		in	mm
⅜	9.5	not recommended	—	—
½	12.7	perpendicular only	16	406
⅝	15.9	perpendicular only	24	610

Note: For adhesively laminated double-layer applications with ¾″ or more total thickness, 24″ o.c. max.

3. Water-based texturing materials applied to ceilings should be completely dry before insulation and vapor retarder are installed. Drying time in days for different temperature and humidity conditions are shown in the chart below:

relative humidity	temperature				
	°F 50	60	70	80	90
	°C 10	16	21	27	32
10%	6.1	4.1	2.9	2.0	1.5
20%	6.7	4.7	3.2	2.3	1.6
30%	7.6	5.3	3.5	2.6	1.8
40%	8.5	5.8	4.1	2.9	2.0
50%	10.5	7.0	5.0	3.5	2.6
60%	12.3	8.5	5.8	4.1	2.9
70%	15.8	11.1	7.6	5.5	4.1
80%	22.8	15.8	11.1	7.9	5.5
85%	28.0	21.0	14.0	9.9	7.3
90%	42.0	29.8	21.0	14.3	10.5
92%	56.0	35.0	24.5	17.5	12.8
94%	70.0	49.0	35.0	22.8	15.8
96%	98.0	70.0	49.0	35.0	24.5
98%	182.0	126.0	84.0	63.0	42.0

preparation

All surfaces must be dry, clean and sound. Dull glossy surfaces; prime metal with a good rust inhibitive primer. Fill and seal wood surfaces. New concrete should age 60 days or more before covering. Remove form oils, grease, efflorescence. Grind down plane differences and remove grinding dust and sludge. Fill or level with DURABOND Joint Compound or COVER COAT Drywall Compound. Reinforce and conceal drywall joints using PERF-A-TAPE Reinforcing Tape and a U.S.G. joint compound. Fill all fastener depressions with joint compound. Smooth surface scratches and scuffs. Correct plane irregularities, as these are

accentuated by sharp, angular lighting. When prepared surfaces are dry and free of dust, apply a good quality white alkyd flat wall paint, or latex or solvent-based primer/sealer over entire surface. *NOTE: Application of a primer is to equalize the surface porosity and to provide a uniform color. Primers are not intended to reduce sag potential.*

USG Multi-Purpose Texture Finish

Mixing—Use a clean mixing vessel equipped with variable-speed power agitator. In initial mix, stir 25 lb. powder into 2 gal. water. Allow to soak for at least 15 min.—longer in cold water. Remix until creamy, lump-free mix is obtained, then stir in up to 1 gal. water. To obtain suitable consistency for texturing as desired, do not use more than 3 gal. water per 25 lb. powder. Do not overthin as poor adhesion, lack of hide and texture variation may result. Do not intermix with other materials.

Application—Apply with brush, roller or with suitable spray equipment at rate of 50 to 100 lb./1000 ft.^{2}; then texture with roller or other tool. For finer textures and designs, use small brush, roller-stippler, the fingers, whisk broom, crumpled paper, comb or similar items. Flatten raised portions of wet material or sand it when dry to provide further variation. May be scored to represent block, tile or cut stone outlines. Maintain 55°F. (13°C) minimum air and surface temperature during application and until surface is dry. Avoid drafts while applying, but provide ventilation after application to aid drying. Do not use unvented gas or oil heaters. May be painted after overnight drying. Ceilings may be left unpainted.

USG Spray Texture Finish

Mixing—Use a clean vessel equipped with variable-speed power agitator. In initial mix, stir 25 lb. powder into 2 to 2½ gal. water, agitating during powder addition. Allow to soak for at least 15 min.—longer in cold water. Remix until a creamy, lump-free mix is obtained. Adjust spray consistency by adding small amounts of powder or water. Do not overthin, as poor adhesion, lack of hide and texture variation may result.

Equipment—Use equipment similar to Binks No. 18D gun with 53-R-21 nozzle combination, ½-in. fluid hose, ⅜-in. air hose, air-powered 4-to-1 ratio materials pump with double regulators, ½-in. main line air hose and 7½- to 9-hp gasoline compressor.

Application—Apply with brush, roller or with suitable spray equipment at rate of 20 to 50 lb./1000 ft.^{2} Spray using 16″ to 20″ fan. Hold gun 16″ to 18″ from surface. Overlap preceding application with ½ to ⅔ of fan width. With 75 to 125 ft. of ½″ hose, use 30 to 40 lb. fluid pressure and 50 to 60 lb. atomizing pressure. Then texture with roller or other tool. For finer textures and designs, use small brush, roller-stippler, the fingers, whisk broom, crumpled paper, comb or similar items. Flatten raised portions of wet material or sand it when dry to provide further variation. May be scored to represent block, tile or cut stone

outlines. Maintain 55°F. (13°C) minimum air and surface temperature during application and until surface is dry. Avoid drafts while applying, but provide ventilation after application to aid drying. Do not use unvented gas or oil heaters. May be painted after overnight drying. Ceilings may be left unpainted.

USG Texture XII Drywall Surfacer

Mixing—Place 1½ gal. of water per 25 lb. Texture XII in suitable mixing container. Gradually add powder to water. Stir thoroughly with mechanical mixer until completely mixed and lump-free. Soak mix for 15 min.—longer in cold water; remix. Gradually add under agitation up to 1¾ gal. of water to reach desirable spraying consistency. Overthinning may result in poor adhesion, lack of hide, texture variation and inability to compensate for base suction variations. *Do not exceed* 3¼ gal. total water per bag. Use within 24 hours.

Equipment—Spray equipment: Hackel Bros. (Milwaukee, Wisc.) Model 18 or 18D special with #68 stainless-steel fluid nozzle, orifice size .110; air nozzle #101 carbide; atomizing pressure at gun 40-50 psi; air-hose size ⅜ in. i.d. with ⅜-in. swivel; fluid hose size ½ in. i.d. with ½-in. swivel; control-hose size 3/16 in. with ¼-in. swivel. Air-driven pump sizes: 4½:1 ratio for hose lengths up to 125 ft.; 7½:1 for lengths up to 200 ft.; 10:1 for lengths over 200 ft.

Application—Walls—Apply with spray gun using 24-in. fan. Hold gun 18 in. from surface and move parallel to surface. Avoid curved, sweeping strokes. Overlap preceding application with ½ to ⅔ of fan width. Do not exceed 28½ lb./1000 ft.^{2} of Texture XII Surfacer. Use ½-in. fluid hose with fluid-pressure variable depending on material hose-length. Air and surface temperatures should be 55°F. (13°C) or higher during, and for several hours after, application. Avoid drafts while applying, then provide adequate circulating ventilation to aid drying.

Application—Ceilings—Apply a full coat in one direction, then immediately cross-spray in opposite direction. Apply Texture XII Drywall Surfacer at rate of approx. 50 lb./1000 ft.^{2} Application techniques to extend coverage accentuates suction or other differences in surface being coated and may require additional coats of Texture XII Surfacer. Material dries to touch in approx. 60 min.; allow to dry overnight before applying another coat.

IMPERIAL QT Spray Texture Finish (P-Medium) (PC-Coarse) (PS-Super Coarse)

Mixing—Use clean vessel equipped with variable-speed power agitator. Sift texture finish into the recommended amount of water, agitating water during powder addition. Allow to soak for at least 15 min.—longer in cold water. Remix until a creamy (but aggregated) lump-free mix is obtained. Adjust spray consistency by adding small amounts of powder or water. Do not overthin, as poor adhesion, lack of hide and texture variation may result.

optional mixing directions

a. Adding joint compound to ceiling texture—If *slightly* better spray properties, wet hide, improved bond and surface hardness are desired, one bag of Finish may be mixed with one bag of USG Powder Joint Compound-All Purpose. Water dilution should not exceed the total of specified amounts for each of the products used. Resultant texture will be slightly less aggregated and the appearance could be less white than the straight texture product. Surface-priming recommendations still apply.

b. Adding latex emulsion to ceiling texture—If increased bond and surface hardness are desired, *USG Latex Emulsion for Imperial QT Texture* may be added to the ceiling texture wet-mix at a rate of 1 to 2 pints per bag of Finish. The more latex emulsion used, up to 2 pints, the greater the bond and hardness of the dried surface. Surface-priming recommendations still apply.

c. Adding paint to ceiling textures—If better wet and dry hide, improved surface hardness, wider spray fan, and faster spray application are desired, a good-grade, compatible polyvinyl acetate, vinyl-acrylic, or acrylic-type paint in *white, off-white or pastel colors only* may be added to ceiling texture wet-mix at a rate of 1 gal. per 32-, 40- or 50-lb. bag of texture by substituting 1 gal. paint for 1 gal. water. When adding 1 gal. paint to a *fully* diluted mix, the above properties remain appreciably the same but a somewhat sparser aggregate surface may result. Also, if aggregate is accidentally brushed off, a lighter-colored surface can result. Interior flat, eggshell or semigloss paint products can be used. Compatibility of paints to be used with Imperial QT products should be carefully checked before use. Exterior-grade latex paints also can be used if compatibility is safisfactory. Surface priming recommendations still apply.

Equipment—Use spray equipment similar to Grover 452-A 10-to-1 ratio, double-action pump with 7½-in. stroke, equipped with 4-ft. pole gun having ⅜- to ½-in. round orifice, or Binks 7-E-2 hand gun with ⅜-in. round opening. Use ¾- to 1-in. material hose, ⅜-in. atomizing hose and ½-in. air line from compressor to pump. Compressor must be adequate (85 cfm) for length and size of hose. Keep pressure as low as possible. Plaster mixers or hopper-type applicators also may be used.

Application—Apply at rate of 6 to 8 sq. ft. per lb. Do not exceed recommended coverage, as subsurface defects, variations in base suction of color differences may show through, or lighter texture may result.

Surfaces with uneven suction may require two coats. Let first coat dry before applying second. Remove splatters immediately from woodwork and trim. Maintain 55°F. (13°C) minimum air and surface temperature during application and until surface is dry.

IMPERIAL QT Spray Texture Finish (Perlite-Fine)

Mixing—Use clean vessel equipped with variable-speed power agitator. Sift each 40-lb. bag of Finish into 7 or 8 gal. water, agitating water during powder addition. Allow to soak for at least 15 min.—longer in cold water. Remix until a creamy (but aggregated) lump-free mix is obtained. Adjust spray consistency by adding small amounts of powder or water. Do not overthin, as poor adhesion, lack of hide and texture variation may result.

optional mixing directions

a. Adding joint compound to ceiling texture—If *slightly* better spray properties, wet hide, improved bond and surface hardness are desired, one bag of Finish may be mixed with one bag of USG Powder Joint Compound-All Purpose. Water dilution should not exceed the total of specified amounts for each of the products used. Resultant texture will be slightly less aggregated and the appearance could be less white than the straight texture product. Surface-priming recommendations still apply.

b. Adding latex emulsion to ceiling texture—If increased bond and surface hardness are desired, *USG Latex Emulsion for IMPERIAL QT Texture* may be added to the ceiling texture wet-mix at a rate of 1 to 2 pints per bag of Finish. The more latex emulsion used, up to 2 pints, the greater the bond and hardness of the dried surface. Surface-priming recommendations still apply.

c. Adding paint to ceiling textures—If better wet and dry hide, improved surface hardness, wider spray fan, and faster spray application are desired, a good-grade, compatible polyvinyl acetate, vinyl-acrylic, or acrylic-type paint in *white, off-white or pastel colors only* may be added to ceiling texture wet-mix at a rate of 1 gal. per 40-lb. bag of texture by substituting 1 gal. paint for 1 gal. water. When adding 1 gal. paint to a *fully* diluted mix, the above properties remain appreciably the same but a somewhat sparser aggregate surface may result. Also, if aggregate is accidentally brushed off, a lighter-colored surface can result. Interior flat, eggshell or semigloss paint products can be used. Compatibility of paints to be used with IMPERIAL QT products should be carefully checked before use. Exterior-grade latex paints also can be used if compatibility is satisfactory. Surface priming recommendations still apply.

Equipment—Use spray equipment similar to Grover 452-A 10-to-1 ratio, double-action pump with 7½-in. stroke, equipped with 4-ft. pole gun having ⅜-to ½-in. round orifice, or Binks 7-E-2 hand gun with ⅜-in. round opening. Use ¾- to 1-in. material hose, ⅜-in. atomizing hose and ½-in. air line from compressor to pump. Compressor must be adequate (85 cfm) for length and size of hose. Keep pressure as low as possible. Plaster mixers or hopper-type applicators also may be used.

Application—Apply at a rate of 4 to 8 sq. ft. per lb. Do not

exceed recommended coverage, as subsurface defects, variations in base suction or color differences may show through, or lighter texture may result. Surfaces with uneven suction may require two coats. Let first coat dry before applying second. Remove splatters immediately from woodwork and trim. Maintain 55°F. (13°C) minimum air and surface temperature during application and until surface is dry. Avoid drafts while applying, but provide circulating ventilation to aid drying. Do not use unvented gas or oil heaters. For comfort, use a respirator and protect eyes.

IMPERIAL QT Spray Texture Finish (V-Medium) (VC-Coarse)

Mixing—Use clean vessel equipped with variable-speed power agitator. Sift each 40-lb. bag of Finish into 7 or 8 gal. water, agitating water during powder addition. Allow to soak for at least 15 min.—longer in cold water. Remix until a creamy (but aggregated) lump-free mix is obtained. Adjust spray consistency by adding small amounts of powder or water. Do not overthin, as poor adhesion, lack of hide and texture variation may result.

optional mixing directions

a. Adding joint compound to ceiling texture—If *slightly* better spray properties, wet hide, improved bond and surface hardness are desired, one bag of Finish may be mixed with one bag of USG Powder Joint Compound-All Purpose. Water dilution should not exceed the total of specified amounts for each of the products used. Resultant texture will be slightly less aggregated and the appearance may be less white than the straight texture product. Surface-priming recommendations still apply.

b. Adding latex emulsion to ceiling texture—If increased bond and surface hardness are desired, *USG Latex Emulsion for Imperial QT Texture* may be added to the ceiling wet-mix at a rate of 1 to 2 pints per bag of Finish. The more latex emulsion used, up to 2 pints, the greater the bond and hardness of the dried surface. Surface-priming recommendations still apply.

c. Adding paint to ceiling textures—If better wet and dry hide, improved surface hardness, wider spray fan, and faster spray application are desired, a good-grade, compatible polyvinyl acetate, vinyl-acrylic, or acrylic-type paint in *white, off-white or pastel colors only* may be added to ceiling texture wet-mix at a rate of 1 gal. per 40-lb. bag of texture by substituting 1 gal. paint for 1 gal. water. When adding 1 gal. paint to a *fully* diluted mix, the above properties remain appreciably the same but a somewhat sparser aggregate surface may result. Also, if aggregate is accidentally brushed off, a lighter-colored surface can result. Interior flat, eggshell or semi-gloss paint products can be used. Compatibility of paints to be used with Imperial QT products should be carefully checked before use. Exterior-grade latex paints also can be used if compatibility is satisfactory. Surface priming recommendations still apply.

Equipment—Use spray equipment similar to Grover 452-A 10-to-1 ratio, double-action pump with 7½-in. stroke, equipped with 4-ft. pole gun having ⅜- to ½-in. round orifice, or Binks 7-E-2 hand gun with ⅜-in. round opening. Use ¾- to 1-in. material hose, ⅜-in. atomizing hose and ½-in. air line from compressor to pump. Compressor must be adequate (85 cfm) for length and size of hose. Keep pressure as low as possible. Plaster mixers or hopper-type applicators also may be used.

Application—Apply at rate of 4 to 8 sq. ft. per lb. Do not exceed recommended coverage, as subsurface defects, variations in base suction or color differences may show through, or lighter texture may result. Surfaces with uneven suction may require two coats. Let first coat dry before applying second. Remove splatters immediately from woodwork and trim. Provide 55°F. (13°C) air and structural temperature during and after application. Do not use unvented gas or oil heaters. Avoid drafts while applying, but provide adequate circulating ventilation to aid drying. For comfort, use a respirator and protect eyes.

IMPERIAL QT Spray Texture Finish (ST-Medium) (STC-Coarse)

Mixing—Use clean mixing vessel equipped with variable-speed power agitator. Sift each 40-lb. bag of Finish into 7 or 8 gal. water, agitating water during powder addition. Allow to soak at least 15 min.—longer in cold water. Remix until a creamy (but aggregated) lump-free mix is obtained. Adjust spray consistency by adding small amounts of powder or water. Do not overthin, as poor adhesion, lack of hide and texture variation may result. Do not intermix with other materials.

optional mixing directions

a. Adding joint compound to ceiling texture—If *slightly* better spray properties, wet hide, improved bond and surface hardness are desired, one bag of Finish may be mixed with one bag of USG Powder Joint Compound-All Purpose. Water dilution should not exceed the total of specified amounts for each of the products used. Resultant texture will be slightly less aggregated and the appearance may be less white than the straight texture product. Surface-priming recommendations still apply.

b. Adding latex emulsion to ceiling texture—If increased bond and surface hardness are desired, *USG Latex Emulsion for Imperial QT Texture* or *Imperial QT Latex Additive*—available in 1 gal. containers—may be added to the ceiling texture wet-mix at a rate of 1 to 2 pints and 1 gal. respectively per bag of Finish. The more latex emulsion used, up to 2 pints, the greater the bond and hardness of the dried surface. Surface-priming recommendations still apply.

c. Adding paint to ceiling textures—If better wet and dry hide, improved surface hardness, wider spray fan, and faster spray application are desired, a good-grade, compatible polyvinyl acetate, vinyl-acrylic, or acrylic-type paint in *white, off-white or*

pastel colors only may be added to ceiling texture wet-mix at a rate of 1 gal. per 40-lb. bag of texture by substituting 1 gal. paint for 1 gal. water. When adding 1 gal. paint to a *fully* diluted mix, the above properties remain appreciably the same but a somewhat sparser aggregate surface may result. Also, if aggregate is accidentally brushed off, a lighter-colored surface can result. Interior flat, eggshell or semi-gloss paint products can be used. Compatibility of paints to be used with IMPERIAL QT products should be carefully checked before use. Exterior-grade latex paints also can be used if compatibility is satisfactory. Surface priming recommendations still apply.

Equipment—Use spray equipment similar to Grover 452-A 10-to-1 ratio, double-action pump with 7½-in. stroke, equipped with 4-ft. pole gun having ⅜- to ½-in. round orifice, or Binks 7-E-2 hand gun with ⅜-in. round opening. Use ¾- to 1-in. material hose, ⅜-in. atomizing hose and ½-in. air line from compressor to pump. Compressor must be adequate (85 cfm) for length and size of hose. Keep pressure as low as possible. Plaster mixers or hopper-type applicators also may be used.

Application—Apply at rate of 4 to 8 sq. ft. per lb. Do not exceed recommended coverage, as subsurface defects, variations in base suction or color differences may show through, or lighter texture may result. Surfaces with uneven suction may require two coats. Let first coat dry before applying second. Remove splatters immediately from woodwork and trim. Maintain 55°F. (13°C) minimum air and surface temperature during application and until surface is dry.

Avoid drafts while applying, but provide adequate circulating ventilation to aid drying. For comfort, use a respirator and protect eyes.

USG Texture I

Mixing and Tinting—Ready-to-use as it comes in the can. Stir, then "box" by pouring from one container into another until completely blended. For best results do not thin. If required, thin sparingly with water—no more than one or two ounces per gallon. A variety of colors can be produced with U.S.G. machine colorants. After using colorant, shake well, and if not used immediately, stir well for complete color dispersion. Do not use colors-in-oil or dry colors for tinting.

Application—Brush on liberal coat of material using a 6″ Baby Dutch brush or wallcoater. For texture, roll immediately with well primed roller, using little or no pressure. Do not apply on too large an area or allow paint to set before rolling. Atmospheric conditions and suction of surface being treated will govern how long paint retains ability to be textured. A long nap lambs wool roller will give best results. Clean any spatters promptly with a damp cloth. Avoid drafts during application, but provide ventilation after painting. Best application conditions are room temperatures between 60° and 80° F, (16° and 27°C) and relative humidity at 40% or higher. Store in moderate temperature. Protect from freezing.

USG Texture II

Mixing and Tinting—Ready-to-use as it comes in the can. Stir, then "box" by pouring from one container to another, until completely blended. Normally material requires no thinning; however, under extremely dry conditions, one to two ounces of water can be added per gallon. Do not overthin. Do not use turpentine, mineral spirits or other types of thinner. A variety of colors is possible by tinting with U.S.G. machine colorants.

application

a. Roller—Apply by roller, choosing length of nap to provide type and size of stipple pattern desired. Long-nap rollers will provide easier spreading and higher, farther spaced texture peaks.

b. Brush and Roll—Material may be spread with a large brush, and subsequently textured with a roller by lightly rolling after a short waiting period (time should be determined by trial and depends on the porosity of surface as well as drying conditions). Continued rolling as the paint gets dryer will tend to reduce texture.

Do not spread out too far, as thick films are necessary to obtain good texture. Wash spatterings quickly with damp cloth. Provide proper heat and ventilation for proper drying. Store paint at moderate temperatures and keep from freezing. Keep containers tightly closed.

TEXOLITE Sanded Paste Stipple

Mixing—May be used at can consistency or consistency may be adjusted by adding up to a maximum of one pt. water per gal. of product, or up to a maximum of 2½ qt. water per five gal. of product. Add water slowly. Avoid over-thinning which reduces hide and texture appearance.

application

Brush or roller—Apply generously and uniformly. Keep roller well filled and work to wet edge. Apply in long strokes. After several applications of full roller, cross-roll lightly. Avoid rolling too thinly and too often. Avoid drafts during application but provide proper ventilation when work has been completed.

Airless Spray—Apply using 10 to 16 inch fan. Hold gun 12 to 16 inches from surface, depending on applicator's technique. Overlap preceding application with approximately one-third of fan width. Atmospheric and structural temperatures should be 50°F. (10°C) or higher during and for several hours after application. Avoid drafts while applying, then provide adequate ventilation to aid drying.

USG Hi-Build Ready-Mixed Texture Finish

Mixing and Thinning—Product is ready-to-use but slight mixing will increase creaminess of the product. To mix, transfer contents into a suitable vessel. Use a heavy-duty drill; 300-600 RPM under load is best—with an open blade mixer paddle. Heavier drills also may be used, but they tend to whip air bubbles into the product. Plunge the mixer paddle up and down in the mix about 10 times before switching on drill, then mix until smooth and uniform.

Thin with water, adjusting proportions to match product viscosity to individual requirements. For trowel application, use without thinning or add up to 1 pt. water max. per 61.7 lb. texture finish. For heavy brush application, add 1 pt. water per 61.7 lb. finish; for roller application, add up to 4 pt. water max. per 61.7 lb. finish. When aggregate is included a maximum of 1¼ gal. water per 61.7 lb. finish may be added. Tinting is not recommended.

One of the following aggregates may be added per 61.7 lb. texture finish:

a. Up to 8 lb. vermiculite.
b. Up to 7 lb. perlite.
c. Up to 15 lb. white, silica sand.

If large areas are being textured, use containers bearing identical manufacturing codes to cover entire area to prevent color differences. Add exactly the same amount of water to each batch of ready-mixed texture finish to prevent color differences.

Application—Apply finish with trowel, roller or brush but troweling provides best results. For trowel application, spread finish at rate of 45 to 90 ft.^{2} per 61.7 lb. pail. For heavy brush application, spread at rate of 67 to 112 ft.^{2} per 61.7 lb. pail. For roller application, use spread rate not to exceed 224 ft.^{2} per 61.7 lb. pail (275 lb./1000 ft.^{2}). Protect from freezing in containers during application and in place until dry. Maintain 55°F. (13°C) min. air and surface temperature during application and until texture is dry. Avoid drafts, but provide good circulating ventilation. Do not use unvented gas or oil heaters.

Ceilings must be primed and may be optionally painted after drying. All walls must be painted after texturing.

USG Ready-Mixed Texture Compound

Mixing and Thinning—Product is ready-to-use but slight mixing will increase creaminess of the product. To mix, transfer contents into a suitable vessel. Use an open-blade mixer paddle on a heavy-duty drill, preferably at 300-600 RPM under load—higher speeds tend to whip air bubbles into the product. Plunge the mixer paddle up and down in the mix about 10 times before switching on drill. Mix, adding water as recommended, until smooth and uniform, always keeping paddle completely immersed to avoid whipping in air bubbles.

Thin with water, adjusting proportions to match product viscosity to individual requirements. For brush or roller/crow foot pattern,

add 1 to 1½ gal. water per 50 lb. texture; for spray/spatter, add 1¾ to 2 gal. water per 50 lb. texture. Tinting not recommended.

If large areas are being textured, prevent shade differences by using containers bearing identical manufacturing codes to cover entire area. Also, be sure to add exactly the same amount of water to each batch of ready-mixed texture finish.

Application—Apply texture with roller, brush or spray gun, depending on type of finish desired. For spray-spatter texture, apply at rate of 125 lb./1000 ft.^{2} Protect texture compound from freezing, whether in containers, during application or in-place, until dry. Maintain 55° to 80°F. (13° to 27°C) min. air and surface temperature during application and until texture is dry. Avoid drafts, but provide good circulating ventilation. Do not use unvented gas or oil heaters.

Ceilings must be primed and may be optionally painted after drying. All walls must be painted after texturing.

TEXTONE Light Sand Texture

Mixing and Thinning—Use at can consistency or adjust consistency by adding up to one pt. water per gal. of product and up to 3 qt. water per 5 gal. Add water slowly. Avoid overthinning.

Application—Apply generously and uniformly using brush or roller. Keep roller well filled and work to wet edge. Apply in long strokes. After several applications of full roller, cross-roll lightly. Avoid rolling too thinly and too often. Avoid drafts during application but provide proper ventilation when work has been completed. Protect material from freezing.

TEXTONE Coarse Ceiling Texture

Mixing and Thinning—Use at can consistency or adjust consistency by adding up to one pt. water per gal. of product and up to 3 qt. water per 5 gal. Add water slowly. Avoid overthinning.

Application—Apply texture with a long nap or carpet-type texture roller at a rate of approximately 50 ft.^{2}/gal. Apply a thin coat of texture initially, followed as soon as possible by a heavy coat. When applying heavy coat, completely fill roller (submerge) with texture material. Work material from a dry area into the wet area. This prevents aggregate buildup and uneven appearance. Cross-roll adjoining surfaces to avoid rigiding and framing.

Texture corners and angles by cutting in material with a square brush or broad knife. Then roll as close to the edge as possible to blend in texture with other area. Avoid spreading texture too far as thick films are needed for a good texture. Light roller pressure produces a heavy stippled texture. Heavier pressure eliminates the stipple and produces a finer texture. Re-rolling after material has started to dry will also eliminate the stipple texture.

Avoid drafts during application but provide ventilation when work is finished. Protect material from freezing.

TEXTONE Smooth Design Texture

Mixing and Thinning—Mix until consistency is smooth and uniform. Thinning texture with water prior to use will vary considerably depending on the finished appearance desired and the application methods used. Product is ready-to-use from the container or consistency may be adjusted by adding up to 1 pt. water per gal. of texture to suit individual requirements. For heavy texture pattern, add 2 to 8 oz. water per gal. Smooth Design Texture. For roller and/or "crows foot" pattern, add 8 to 16 oz. water per gal. texture. For spray/spatter pattern, add 16 oz. water per gal. texture; may be adjusted up to 8 oz. additional. Add water slowly with agitation. Avoid overthinning.

Application—Use brush, roller or spray depending on finish desired. For best smooth coat finish, trowel material after initial application. Two applications may be necessary over masonry, textured, rough and porous surfaces. Protect from freezing.

TEXTONE Interior/Exterior Stucco Texture

Surface Preparation: All surfaces (interior or exterior) must be sound, clean, and free of dust or dirt. Surface may be damp but not wet. Remove loose dirt, grease and water-soluble materials. EXTERIOR USE: *Masonry:* Let new concrete age at least 60 days or more at temperature over 70°F. Acid etch with phosphoric or muriatic acid, rinse thoroughly with clean water and let dry before texturing. *Wood/Plywood:* Use exterior-grade plywood. Prime with oil-based house primer as recommended by manufacturer and allow to dry. *Asbestos Cement:* Prime with latex-based house primer recommended by manufacturer. *Clean Metal:* Prime with zinc chromate primer as recommended. INTERIOR USE: *Masonry, Gypsum Drywall, Asbestos Cement:* No primer needed but use of an appropriate latex paint as primer may provide a more pleasing appearance with extended coverage of texture finish. *Wood/Plywood:* No primer needed unless bleeding-type wood is involved. *Clean Metal:* Prime with rust inhibitive primer as recommended by manufacturer.

Mixing—Use at can consistency. Thin sparingly with water, if required.

Application—Apply texture with a long nap or carpet-type texture roller at a rate of approximately 50 ft.^{2}/gal. Apply a thin coat of texture initially, followed as soon as possible by a heavy coat. When applying heavy coat, completely fill roller (submerge) with texture material. Work material from a dry area into the wet area. This prevents aggregate buildup and uneven appearance. Cross-roll adjoining surfaces to avoid rigiding and framing.

Texture corners and angles by cutting in material with a square brush or broad knife. Then roll as close to the edge as possible to blend in texture with other area. Avoid spreading texture too far as thick films are needed for a good texture. Light roller pressure produces a finer texture. Re-rolling after material has started to dry will also eliminate the stipple texture.

Avoid drafts during application but provide ventilation when work is finished. Protect material from freezing.

DURACAL Exterior/Interior Spray Texture Finish

Surface Preparation: may be applied to interior or exterior surfaces prepared same as described on the container.

Mixing—Use material as supplied. Thin sparingly with water, if required.

Application—Spray with high pressure spray equipment. It is imperative for maximum durability and water resistance that all textured surfaces be free of voids and completely coated with texture. To eliminate voids in the sprayed texture paint, apply a mist coat or "skim coat" by spray and then trowel lightly. A full texture coat, thereafter, will cover all exposed masonry and eliminate pinholes. In order to meet Fed. Specification TT-C-555B, apply material at a rate of 40 to 50 sq. ft. per gal.

resurfacing

Where ceilings or sidewalls are so badly disfigured that an entirely fresh surface is desirable, they may be resurfaced using a layer of 1/4" or 3/8" SHEETROCK Brand Gypsum Panels or predecorated TEXTONE Vinyl-Faced Panels. Ceilings may also be redecorated with texture finishes. For resurfacing masonry walls, see application of gypsum board to wall furring, described earlier in this chapter.

Preparation—Remove all trim (this may not be necessary if 1/4" panels are used). To remove trim easily, drive all nails completely through the trim with a pin punch. Remove all loose surfacing material. Fill small holes with joint compound or patching plaster. Patch large holes to the surrounding level with single or multiple layers of gypsum board nailed to framing and shimmed out as required.

Electrical outlet boxes for switches, wall receptacles and fixtures should be extended outward to compensate for the added gypsum panel thickness.

Locate joists and studs by probing or with a magnetic "stud finder." Snap a chalk line to mark their full length and mark their location on the adjacent wall or ceiling. Where great irregularities of surface exist, apply furring strips not over 16" o.c., using wood shingles to shim out to a true, even plane.

Installation—Apply SHEETROCK Brand Panels with long dimension placed horizontally or vertically. Fasten with gypsum board nails, spaced 7" o.c. on ceilings, 8" on walls. Nails must be long enough to penetrate into framing members at least 5/8". Nail TEXTONE Vinyl-Faced Panels over existing walls with matching color nails using a plastic-headed hammer.

Gypsum panels may be adhesively applied over sound, existing walls with laminating adhesive for regular or irregular surfaces or liquid contact adhesive for flat, smooth surfaces (see directions, this chapter), or with a DURABOND Joint Compound.

Finish SHEETROCK Brand Panels with metal corner reinforcement and joint treatment as necessary, and replace all trim.

redecorating ceilings

Redecorating cracked, discolored or damaged ceilings with texture can make old ceilings look like new. Spray-applied texture finishes cover cracks and imperfections and provide beautiful surfaces. Redecorating over large-aggregate texture surfaces is especially effective since these surfaces normally are not easily cleaned, rolled or brush-painted. Yet they are easily spray-painted with texture. These modernized ceilings add value and beauty. Best of all, most jobs can be done in one day without removing rugs, furniture or light fixtures.

Preparation—Surface cracks larger than hairline size should be treated with a drywall joint compound and tape, and thoroughly dried, prior to redecorating. Nicotine-stained surfaces, unless heavily deposited, should require no predecorating attention. Remove grease stains using mild detergent. Seal water-stained surfaces with primer specifically recommended by the manufacturer. Remove soot or dirt by "air dusting" surfaces. Wash mildew-contaminated surfaces with a solution of 1 qt. household bleach such as Clorox (sodium hypochlorite) to 3 qt. water. Cover all furniture, rugs, etc. with drop cloths and wear gloves and protective clothing as well as eye protection. For heavy mildew deposits, two applications of the bleach solution may be necessary. On textured ceilings, heavy coats of bleach are not recommended. Mist-coat surface with bleach solution using an aerating device such as a trigger-type household sprayer. No rinsing of the bleach solution is necessary since this would rewet the texture and cause serious bond problems. Let bleach dry thoroughly, then respray surface with IMPERIAL QT Spray Texture Finish.

On previously painted mildew-contaminated surfaces, apply bleach solution with a scrub brush. When dry, rinse the painted surface to remove bleach, dry, and then spray-apply desired texture finish.

Caution. Treatment for mildew will not necessarily prevent its recurrence if humidity, temperature and moisture conditions are favorable for further mildew growth.

redecorating with texture

Painted surfaces—Ceilings that have been painted with pastel flat alkyd or latex flat paints can be sprayed with no special pretreatment if free of grease or dirt. On dark painted ceilings, prime with white latex or alkyd flat ceiling paint. Dull semi-gloss surfaces completely by sanding lightly. "Liquid" sandpapers are not recommended. *Previously textured surfaces*—Priming a previously textured ceiling with a paint primer is not necessary. If required, one or two coats of a good-quality latex wall paint is sufficient prior to redecorating with a coarse texture only. *Wallpaper or vinyl wall covering*—Remove material and prime ceiling surface with appropriate primer prior to texturing. *Plaster ceilings*—Surface must be in paintable condition. Prior to texturing, cover with primer-sealer specifically recommended by paint manufacturer.

Mask surfaces by covering floors and walls with .85- to 1-mil-thick polyethylene film, available in 8-ft. widths, folded and rolled in half for easier handling. Spread polyethylene film on floor, making sure that all areas are completely covered. Next, apply wide masking tape to wall-ceiling intersection, fastening only top of tape to wall and leaving bottom hanging free. Fasten one edge of folded poly film to loose edge of tape, then unfold film to full 8-ft. width. Press tape into firm contact with both wall and film.

Cover furniture, cabinets, light fixtures—anything that will remain in the room during spraying operation. Building owner usually is responsible for having ceiling light fixtures lowered so they can be quickly and completely covered.

Mixing—Use clean mixing vessel equipped with variable-speed power agitator. Sift texture material into the recommended amount of water, agitating water during powder addition. Stir until a creamy (but aggregated) lump-free mix is obtained. Adjust spray consistency by adding small amounts of powder or water. Do not overthin, as poor adhesion, hide and texture variation may result. Do not intermix with other materials.

Equipment—Use spray equipment similar to Grover 452-A 10-1 ratio, double-action pump with 7½-in. stroke, equipped with 4-ft. pole gun having ⅜- to ½-in. round orifice, or Binks 7-E-2 hand gun with ⅜ in. round opening. Use ¾- to 1-in. material hose, ⅜-in. atomizing hose and ½-in. air line from compressor to pump. Compressor must be adequate (85cfm) for length and size of hose. Keep pressure as low as possible. Plaster mixers or hopper-type applicators also may be used.

Application—Apply IMPERIAL QT Spray Texture Finishes at a rate of 125 to 165 lb./1000 ft.^{2} Do not exceed recommended coverage, as subsurface defects, variations in base suction or color differences may show through, or lighter texture may result. Maintain 55°F. (13°C) minimum air and surface temperature during application and until surface is dry.

redecorating a textured surface with paint

Brush application of paint over a textured ceiling is not recommended. In redecorating by hand, use a long-nap paint roller with ½- to ¾-in. nap. Any good-quality polyvinyl acetate, acrylic, or vinyl acrylic paint in flat, egg-shell, or semi-gloss can be used. Slight dilution of paints with water, particularly high-viscosity types, may be necessary for smoother, easier spreading. Apply paint by rolling in one direction, immediately followed by cross-rolling. Use light pressure and avoid over-rolling and saturating the surface to minimize loosening of surface aggregate.

Whether spraying or rolling, avoid drafts while applying, but provide adequate circulation and ventilation to aid drying.

precautions

When mixing, spraying, or working in a dusty atmosphere containing these materials, ventilate, use dust collector, or wear eye protection and a respirator approved by the Bureau of Mines, or equivalent.

chapter 3

drywall and veneer construction

system performance and installation

system technical data

U.S.G. leads the industry in development of performance-engineered systems to meet specialized requirements for modern building design. These systems provide fire resistance, sound control, structural capacity and esthetics for improved function and utility while reducing construction time and cost. All are constructed of quality products and released only after thorough testing and field trial.

Fire and Sound Tests

Fire and sound test data aid in comparing and selecting materials and constructions. In addition, these data frequently are essential for securing building code or agency approval. The U.S.G. Construction Selector SA-100 provides tested fire resistance and acoustical performance for various systems. The following criteria are used for comparison.

A *fire-resistance rating* denotes the length of time a given assembly can withstand fire and give protection from it under precisely controlled laboratory conditions.

The *Sound Transmission Class (STC)* is a numerical evaluation of an assembly's effectiveness in isolating airborne sound transmission. As with fire tests, sound tests are conducted under precisely controlled laboratory conditions.

The *Impact Insulation Class (IIC)* is a numerical evaluation of a floor-ceiling assembly's effectiveness in retarding the transmission of impact sound, also determined from laboratory testing.

Fire and sound tests are conducted on U.S.G. products assembled in a specific manner to meet requirements of established test procedures. Substitution of materials other than those tested or deviation from the specified construction may adversely affect performance and result in failure. For complete information on test components and construction, see the test report.

While fire and sound tests are run in a laboratory, these data are often validated by subsequent field tests. A more comprehensive discussion of fire and sound testing can be found in the Appendix. United States Gypsum leads the industry in documentation of performance of its wall and ceiling systems by recognized testing laboratories.

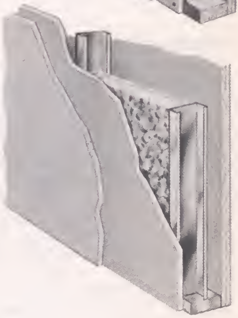
system descriptions

U.S.G. leads the industry in high-performance systems for building construction—fire ratings up to 4 hours for partitions, shaft walls and column fireproofing; 3 hours for floor/ceilings, STC values as high as 59. Major U.S.G. partition, ceiling, furring and fireproofing systems are outlined on the following pages.

Wood Stud Partitions

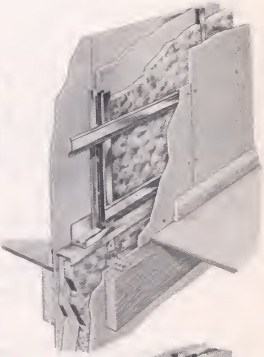
Suitable for residential and light-commercial construction where combustible framing is permitted, these designs include single- and double-layer gypsum board facings, single- and double-row studs, those with insulating blankets, and those with resilient attachment. Performance values of up to 4-hr. fire resistance and 58 STC can be obtained.

Steel Stud Partitions



Suitable for all types of construction, these designs include single- and multi-layer gypsum board facings, with and without THERMAFIBER Sound Attenuation Blankets. Performance values of up to 4-hr. fire resistance and 58 STC can be obtained.

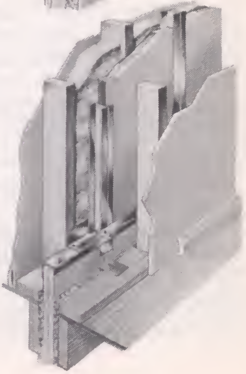
Area Separation Walls



USG Area Separation Walls provide fire and sound barriers between units in multi-family wood-frame buildings. Some code bodies identify this type of wall by other names such as fire wall or barrier, lot line wall or party wall.

These systems can be used in buildings up to four stories high; offer performance values up to 3-hr. fire resistance and STC 57.

There is a choice of two cost-reducing systems—*Cavity Type* and *Solid Type*. Both systems are continuous, vertical, non-load bearing wall assemblies of gypsum panels attached to steel framing that extend from foundation through the roof and act as barriers to fire and sound transmission.



(above)
Cavity-Type Separation Wall

(right)
Solid-Type Separation Wall

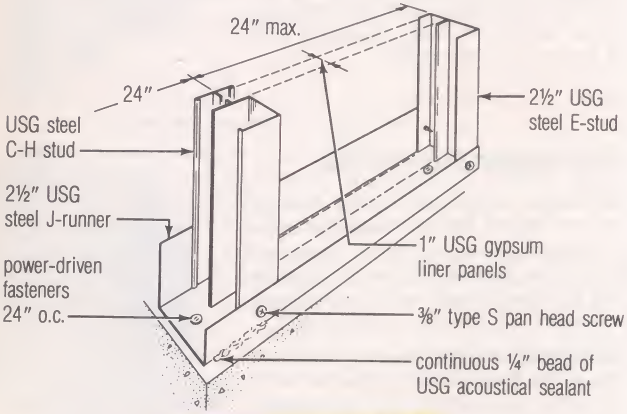
CAVITY SEPARATION WALL

Cavity Walls are intended for use in buildings where load-bearing walls *are not* used at the line of separation between units. For that reason they are the thinnest of all fire walls. U.S.G.'s 3-hr. Area Separation Wall is a mere 4⅞″ thick, and the 2-hr. version is only 3½″ thick.

These assemblies are erected by carpenters during completion of rough framing and setting of roof trusses. This factor allows tight job schedules and faster completion than is possible with masonry fire walls. The superior sound rating of these walls helps speed sales or rentals and reduces turnover.

installation

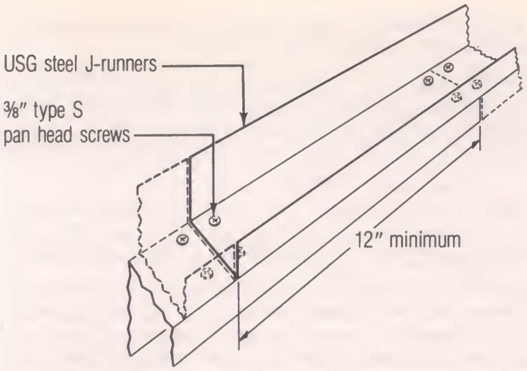
Foundation—Position 2½″-wide steel J-runner at floor and securely attach to foundation with power-driven fasteners at both ends and spaced 24″ o.c. When sound control is required, caulk perimeter with USG Acoustical Sealant except where wing wall and parapet are used.



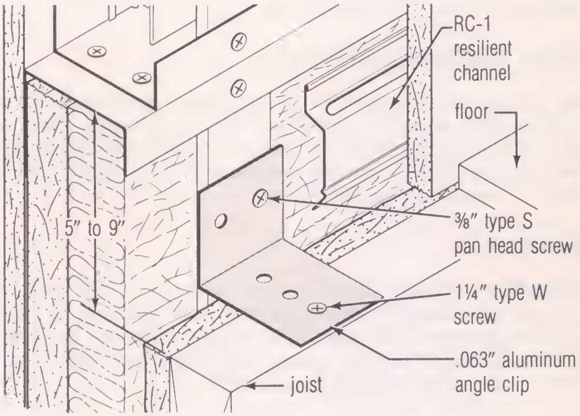
Foundation-Cavity Wall

First Floor—Install 1″ liner panels and steel studs cut to length 5″ to 9″ more than floor-to-floor height. Erect liner panels vertically in J-runner with long edges in groove of C-H stud. Install C-H studs between panels and cap ends of run with E-stud (see detail). Fasten bottom of studs to J-runner flange with ⅜″ Type S Screws.

Intermediate Floors—Cap top of panels and studs with J-runner and fasten studs to one J-runner flange with ⅜″ Type S Screws. Install bottom J-runner for next row of panels over top runner with end joints staggered at least 12″. Fasten runners together with double ⅜″ screws at ends and spaced 24″ o.c. (see detail). Secure each stud to framing with .063″ aluminum angle clip, fastened to studs with ⅜″ screws and to framing or subfloor with 1¼″ Type W Screws (see detail).



J-Runner Splice



Intermediate Floor-Cavity Wall

Roof—Continue erecting studs and panels for succeeding stories as previously described. At roof, cap panels with J-runner and fasten studs to flanges with 3/8″ screws. Fasten studs to framing with aluminum clips.

Sound Attenuation Blankets—Install blankets between studs and attach to liner panel with five 9/16″ staples driven through each blanket, one in center and others spaced 3″ from each corner. Butt ends of blankets closely and fill all voids.

Resilient Channels—When specified, install RC-1 Resilient Channels horizontally to face side of studs, 6″ above floor, 6″ below ceiling joists and max. 24″ o.c. Attach channels to studs with 3/8″ Type S Screws driven through holes in mounting flange. Extend channels to ends of runs and attach to E-studs. Splice channels to ends of runs and attach to E-studs. Splice channel

by nesting directly over stud; screw-attach through both flanges. Reinforce with screws at both ends of splice.

Gypsum Panels—Apply ½″ SHEETROCK Brand W/R FIRECODE "C" Gypsum Panels vertically to both sides of studs. Stagger joints on opposite partition sides. Fasten panels with 1″ Type S Screws spaced 12″ o.c. in field and along edges and runner flanges.

Resilient Single-Layer—Apply ½″ gypsum panels vertically to resilient channels and fasten with 1¼″ Type S Screws placed 6″ away from stud and 12″ o.c. Do not place screws over studs.

Resilient Double-Layer—Apply ⅝″ gypsum panel base layer perpendicular to resilient channels with end joints staggered; fasten with 1¼″ Type S Screws placed 6″ away from stud and 12″ o.c. Apply ⅝″ gypsum panel face layer vertically over base layer with edge joints staggered and attach with 1⅝″ Type S Screws spaced 12″ o.c. and staggered from those in base layer.

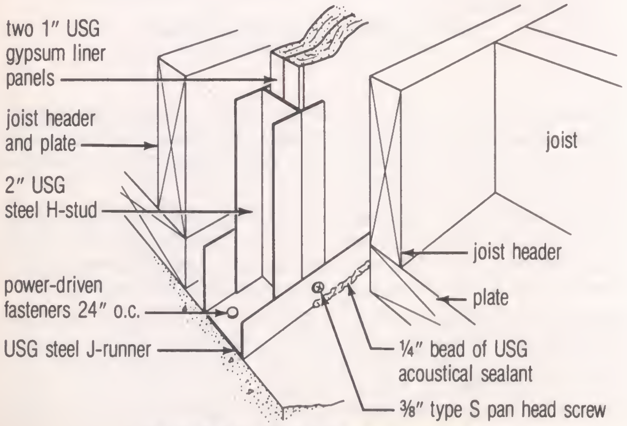
Joint Treatment—After construction is closed in, complete the assembly with a U.S.G. Joint System applied according to manufacturer's current directions.

SOLID SEPARATION WALL

This system is designed for use between load-bearing walls. While the total assembly is thicker than cavity walls, solid walls are no thicker than masonry barriers when used in the same type of construction. And like cavity walls, these assemblies are quickly erected by carpenters.

installation

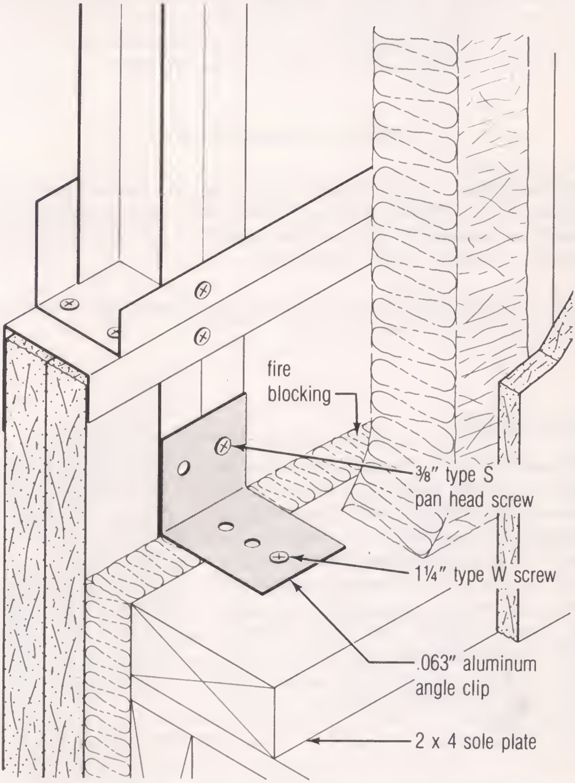
Foundation—Position 2″-wide steel J-runner at floor with short leg toward installation side. Securely attach runner to foundation with power-driven fasteners at both ends and spaced 24″ o.c. Where sound control is required, caulk perimeter with ¼″ bead of acoustical sealant (see detail).



Foundation-Solid Separation Wall

First Floor—Install 1″ liner panels and steel studs cut to convenient length more than floor-to-floor height. Score and snap liner panels. Erect two thicknesses of 1″ liner panels vertically in J-runner with long edges in H-stud. Erect H-studs and double-thickness panels alternately until wall is completed. Install C-stud as cap at ends of run. Fasten all studs to J-runner flange with ⅜″ Type S Pan Head Screws. Install wood blocking between framing at mid-floor height, if necessary, to secure end cap against liner panels.

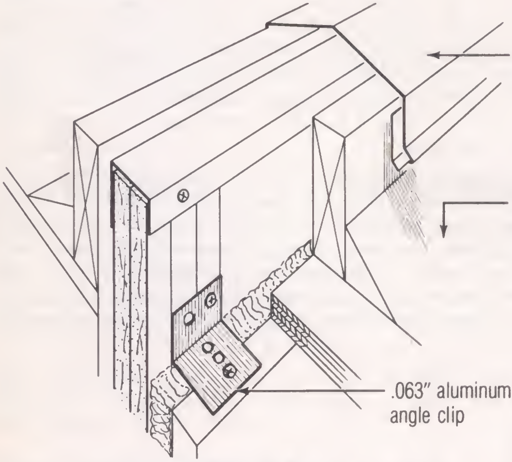
Intermediate Floors—Cap top of panels and studs with back-to-back J-runners screw-attached together with double ⅜″ Type S Screws at ends and spaced 24″ o.c. (see detail). Fasten studs to runner flange with ⅜″ screws. Secure studs to framing with .063″ aluminum angle clips screw-attached to studs with ⅜″ screws and to framing with 1¼″ Type W Screws (see detail). Except at foundation, install fire blocking between joists and fire barrier.



Intermediate Floor-Solid Separation Wall

Roof—Continue erecting studs and panels for succeeding stories as described above. At roof, cap panels with J-runner and

fasten to studs with ⅜″ screws. Fasten studs to framing with aluminum clips.



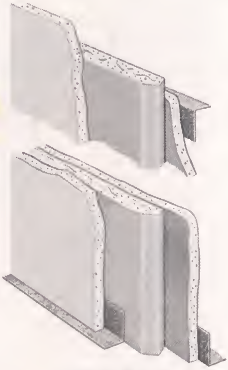
Roof-Solid Separation Wall

Interior Finish—Screw-apply single-layer ⅝″ SHEETROCK Brand FIRECODE "C" Panels to wood studs and caulk perimeter with acoustical sealant. Complete the assembly with the appropriate drywall or veneer finish application.

Note: For additional information on Area Separation Walls, see U.S.G. technical folder SA-925.

Vent Shaft

USG Vent Shaft System provides a 2-hr. fire-rated enclosure for vertical shafts in apartments and other types of multi-story buildings. This shaft assembly is particularly suited for structures having a number of relatively small and widely separated mechanical, service and ventilator shafts. (USG Shaft Walls are preferred where service and mechanical lines and equipment are consolidated within the building core.)



Vent Shaft

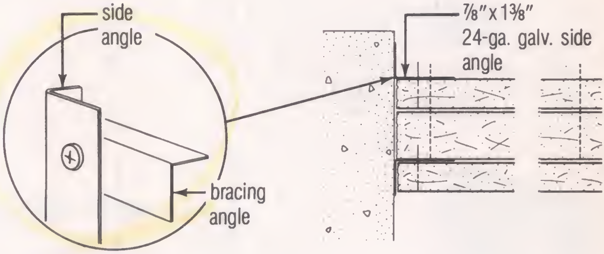
installation

Support Member Attachment—Align floor, ceiling and sidewall runners according to partition layout. Fasten runners securely to structural supports with suitable fasteners 24″ o.c. Install 1⅝″ USG Steel Runners at ceiling by fastening through web. Install

1⅜″×⅞″×24-ga. galvanized steel angles as runners on floor and sidewalls by fastening through their short legs. As an alternate, steel angles may be used as ceiling runners. Install side angle runners 30″ long and centered for attachment of horizontal bracing angles.

alternate ceiling attachment

Bracing Angle Attachment—Install 1⅜″×⅞″×24-ga. galvanized steel bracing angles horizontally at quarter-points between floor and ceiling and spaced max. 5 ft. o.c. Position long leg vertically for board attachment and fasten to sidewall angles with 1″ Type S Screws.

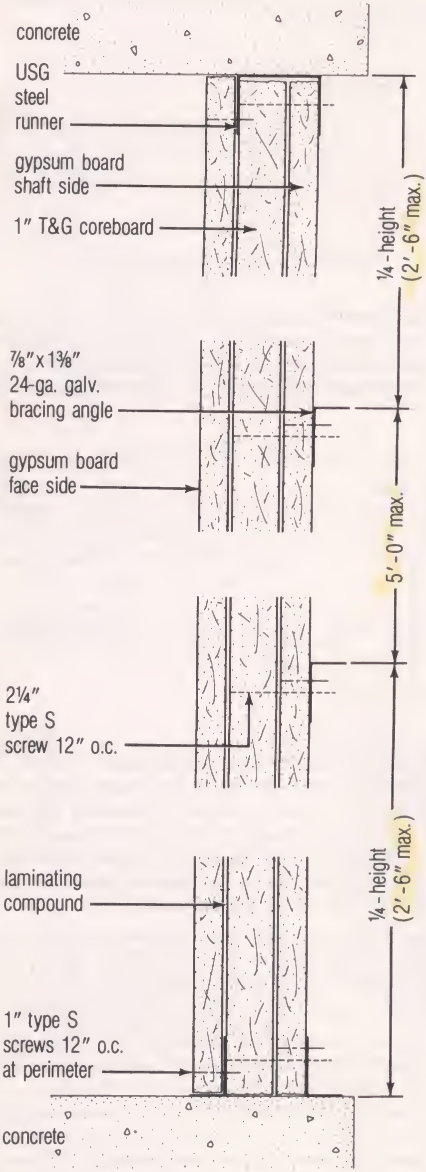


Gypsum Board and Coreboard Application—Install ⅝″ gypsum board (FIRECODE core) vertically on shaft side and fasten to angles and runners with 1″ Type S Screws 16″ o.c. Apply a DURABOND Joint Compound or USG Ready-Mixed Joint Compound—Taping or All Purpose on back side of coreboard and strip or sheet-laminate to shaft-side board with vertical joints offset 12″ from inner board joints.

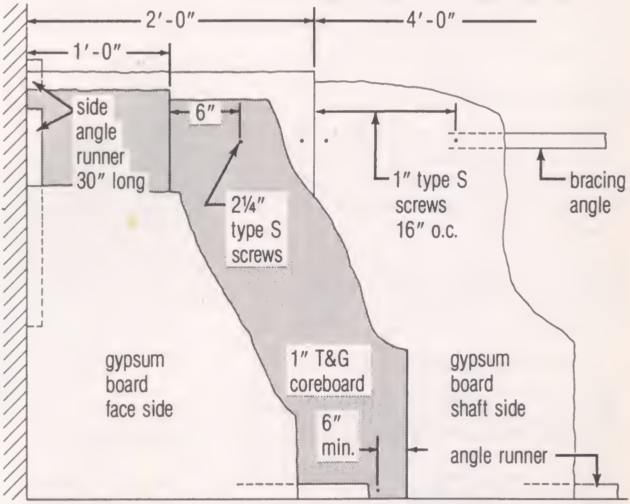
Install second set of floor and sidewall angle runners (and ceiling angles, if required) with long legs against coreboard. Attach coreboard to runners and angles with 2¼″ Type S Screws 12″ o.c. and at least 6″ away from coreboard edges.

Using strip or sheet method, laminate floor-side face board to coreboards with a DURABOND Joint Compound or USG Ready-Mixed Joint Compound—Taping or All Purpose. Install face boards vertically with joints offset 12″ from coreboard joints. Apply moderate pressure when placing boards to assure good adhesive bond. Fasten to coreboard with 1½″ Type G Screws. Drive screws approx. 24″ from ends of board and 36″ o.c. along lines ½″ from vertical edges. Temporary nails or support bracing installed 16″ to 24″ o.c. may be used instead of screws to

Vent Shaft Vertical Sections



maintain bond until adhesive is hard and dry. After all attachments are made, wipe off any adhesive forced out at joints and edges. Caulk perimeter of face panels with acoustical sealant to prevent air infiltration. If desired, complete the assembly with the appropriate drywall or veneer finish application.

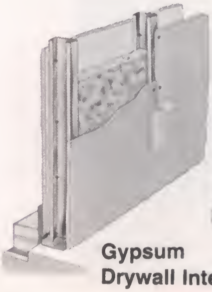


Vent Shaft Elevation

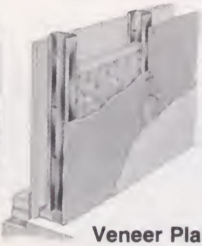
Curtain Walls

USG Exterior Curtain Wall Systems meet a wide range of requirements for non-axial load-bearing exterior walls. USG Steel Studs, modified channel types roll-formed from five thicknesses of steel, provide wall framing for both drywall and veneer systems. Exterior surfaces can be brick veneer, portland cement-lime stucco, decorative panels or siding materials.

Stucco Exterior



Gypsum Drywall Interior



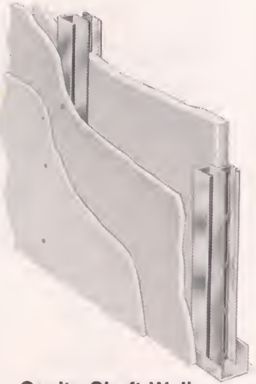
Veneer Plaster Interior

Masonry Exterior

The wide choice of stud sizes and spacings accommodate wall heights to 26′, wind loads to 40 psf, and a variety of building modules.

For complete load and installation data on USG Curtain Walls, refer to technical folder SA-805. Other components are covered in Chapter 6 of this handbook.

Shaft Walls



Cavity Shaft Wall

USG Cavity Shaft Walls provide fire-resistant enclosures for a variety of vertical shafts in multi-story buildings, including stairwells, elevator and mechanical shafts, and large air ducts.

The assemblies consist of gypsum board (FIRECODE core), USG Steel C-H Studs and Steel Runners, and USG Shaft Wall Liner.

Performance values of up to 4-hr. fire resistance and STC 51 can be obtained. In addition, these assemblies will resist lateral loads of up to 15 psf.

For complete data and installation instructions, refer to U.S.G. technical folder SA-922.

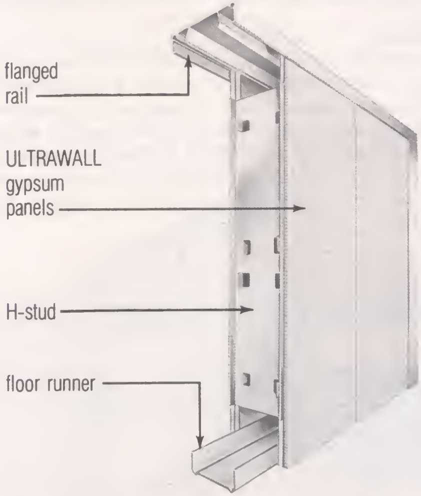
Movable Partitions

USG Demountable Partitions offer complete flexibility in use and virtual 100% reusability. They have one of the highest sound ratings among movable drywall partitions and yet are among the least expensive. Available in ceiling, cornice or bank rail heights, these noncombustible partitions are non-load bearing, yet structurally sound and suitable for use in modernization or all types of new construction. The simplified, coordinated parts are readily available from dealer stocks; they erect quickly and require no special contractor training for assembly or relocation. Electric utilities are rapidly installed or changed.

These assemblies consist of individual wall sections erected from 2½″ steel studs set in steel runners and faced with ½″ TEXTONE Vinyl-Faced Gypsum Panels or regular SHEETROCK Brand Gypsum Panels 48″ wide. Anodized aluminum base, trim, door frames and glazed opening components are furnished to complete the line.

With sound attenuation blankets installed in stud cavity and ½″ SHEETROCK Brand FIRECODE "C" Gypsum Panel facings, the system is fire rated at 1 hour and sound rated at STC 46 (est.). The partition's 3½″ thickness permits quick installation or relocation of mechanical services.

ULTRAWALL Partition Systems are non-load bearing, flush-panel type assemblies, 3⅜″ thick, with four basic components. The simplified designs are available in ceiling, cornice or bank rail height and are distinguished for quick erection, ready movability, up to 2-hour fire ratings and sound ratings up to STC 50.



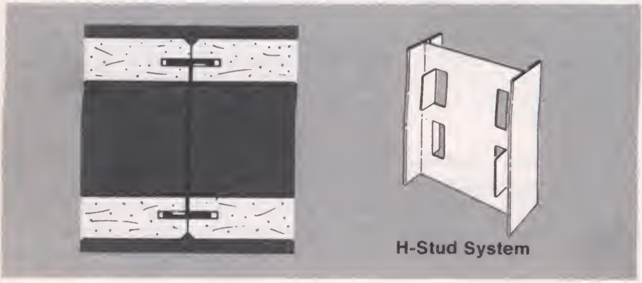
ULTRAWALL Partition construction covered by U.S. Patent No. 3,027,605, other patents pending.

Four basic components provide simplicity in design, layout, estimating, erection, moving, reassembly and replacement.

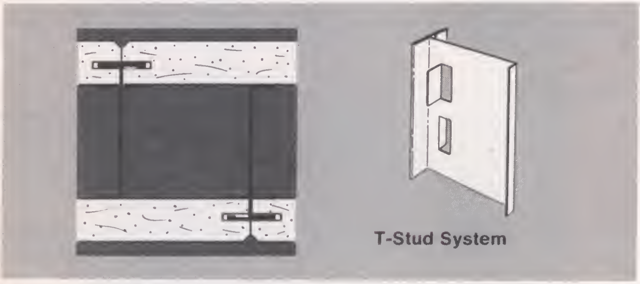
The partitions are constructed of special noncombustible ULTRAWALL Gypsum Panels set in continuous runners and held in place with concealed studs spaced 24″ or 30″ o.c. Three sepa-

rate stud systems meet the widest range of requirements for fast installation, independent erection of partition facings and accessibility. The ULTRAWALL Panels, with edges beveled and integrally grooved to engage the stud, are ¾″ thick, 24″ or 30″ wide and available in mill-laminated vinyl-faced panels or plain panels ready for decoration. Door and borrowed-light openings are neatly formed and trimmed with etched and anodized aluminum, pre-coated steel or vinyl accessories. Installed by authorized erectors.

Each ULTRAWALL partition offers major advantages in simplicity, low cost and design features—combines maximum versatility with speed and economy. Systems can be interchanged in the same installation, as described below, to provide accessible panels only where needed. The only variable is the stud.

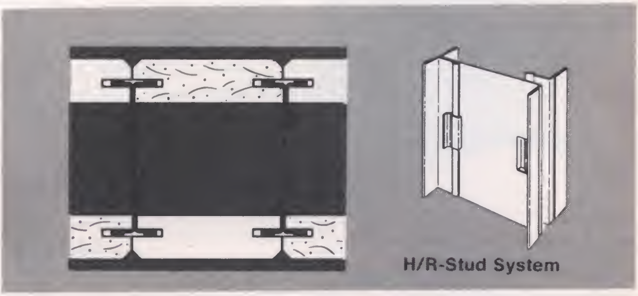


Standard H-Stud System
One of the fastest, simplest movable partitions—outstanding for low cost. The system is assembled, dismantled and reassembled quickly. And because accessibility usually is not required for most buildings (electricians and other trades quickly make changes without removing panels), this ULTRAWALL system is virtually without equal. For quickest installation and lowest in-place cost of the three ULTRAWALL assemblies, specify the standard H-stud system.



T-Stud System
Allows erection of one side of the partition only, if desired. This permits completing the partition after adjoining space is leased,

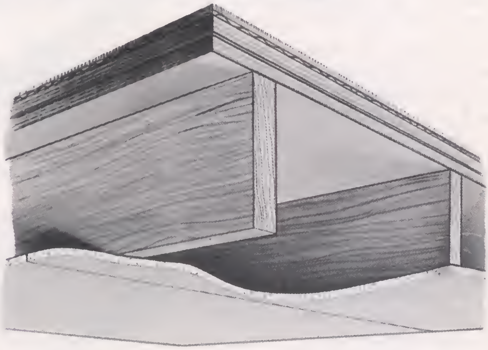
allowing the tenant to select his own surface covering. Additionally, when considerable electrical work is to be installed, it is simpler to leave the partition semi-finished, allowing other trades to complete their work before the second side is enclosed. T-studs may be interchanged with H/R or H-studs. An outstanding choice for tenant or service walls.



H/R Stud System
Provides access with full security. Opposite panels cannot be removed, yet alternate panels are easily removable and replaceable, providing future access to each cavity. H/R-studs snap in place, the same speedy installation as H-studs. They can be used for a single panel, a series or an entire installation. All other components remain the same; only the stud is changed.

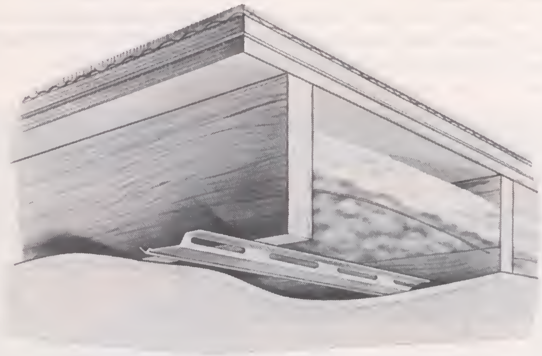
For additional information on ULTRAWALL Partition Systems, see U.S.G. technical folder SA-1020.

Wood Frame Floor/Ceilings



These designs, which are suitable for all types of wood-framed residential and commercial buildings, include those with single- and double-layer gypsum board facings, and other assemblies with THERMAFIBER Sound Attenuation Blankets and resilient attachment.

Performance values of up to 2-hr. fire resistance, STC 52 and IIC 65 can be obtained.

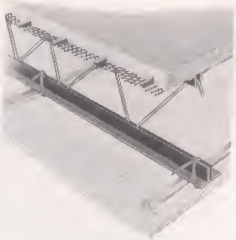


single-layer resilient construction

U.S.G. publishes data for more than 20 tests conducted on resilient wood-frame ceiling assemblies including the only 1-hr. residential gypsum board system for 48″ joist spacing. For complete listings, refer to technical folder SA-924 and U.S.G. Construction Selector SA-100.

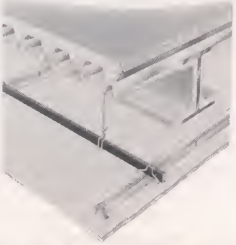
Noncombustible Floor/Ceilings

Noncombustible ceilings with USG Metal Furring Channels conceal and protect structural and mechanical elements above a lightweight fire-resistant layer of gypsum board. The furring channels, to which gypsum board is screw-attached, are wire-tied to bar joists, or clipped or wire-tied to suspended 1½″ main runner channel grillage. Panels are also screw-attached below the USG Direct Suspension System.



Furred Ceiling

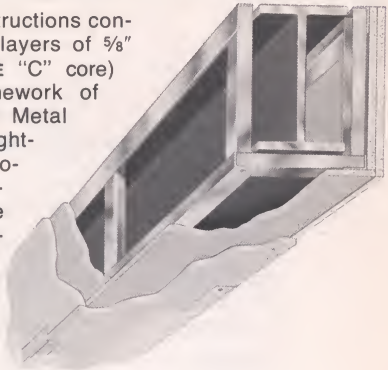
For long-span suspension beneath large ducts or pipes, USG Steel Studs are substituted for furring channels. With foil-back gypsum board the ceiling is effective as a vapor retarder. Also, the board provides a firm base for adhesively applied acoustical tile.



Suspended Ceiling

With these systems, performance values of up to 3-hr. fire resistance (3-hr. beam) and STC 43 and IIC 60 have been obtained.

Caged Beam Construction



USG Caged Beam Constructions consist of double or triple layers of ⅝″ gypsum board (FIRECODE "C" core) screw-attached to framework of USG Steel Runners and Metal Angles. These are lightweight, easily and economically installed assemblies that provide 2-hr. and 3-hr. beam protection.

installation

Suspension System Erection—Erect ceiling runners parallel to and at least ½″ away from beam. Position metal angles with 1⅜″ leg vertical. Fasten ceiling runners to steel floor units with ½″ Type S-12 Pan Head Screws spaced 12″ o.c.

Fabricate channel brackets from 158CR Steel Runners to allow ½″ clearance at bottom of beam for 2-hr. construction and 1″ clearance for 3-hr. assembly. When USG Steel Runners are used for corner runners, cope or cut away legs of runner used for brackets to allow insertion of corner runner. When metal angles are used for corner runners, slit channel bracket runner legs and bend runner to right angle. Install channel brackets 24″ o.c. along the length of the beam and fasten to ceiling runner with ½″ Type S-12 Pan Head Screws.

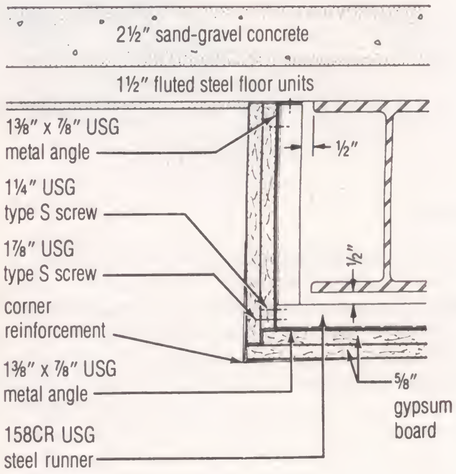
Install lower corner runners parallel to beam. Set USG Steel Runner corner runners in coped channel brackets. Apply metal angles to outside of channel brackets with the ⅞″ leg vertical, and fasten with ½″ Type S-12 Pan Head Screws.

Gypsum Board Erection—For 2-hour assemblies, apply vertical base-layer board and attach to ceiling and corner runners with 1¼″ Type S Screws spaced 16″ o.c. Install base layer to beam soffit overlapping vertical side panels and fasten with 1¼″ Type S Screws 16″ o.c. Apply face-layer boards so soffit board supports vertical side boards. Fasten face layer to runners with 1⅞″ Type S Screws spaced 8″ o.c.

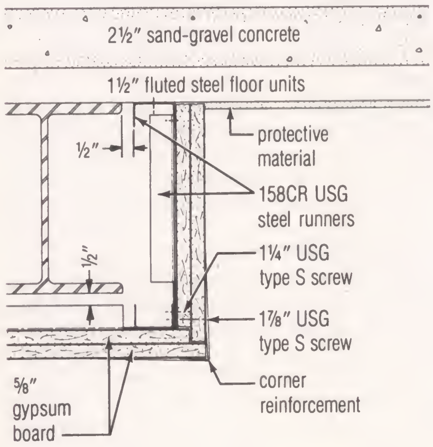
For 3-hour assembly, apply base-layer boards and attach to ceiling and corner runners with 1″ Type S Screws spaced 16″ o.c. Apply middle layer over base layer and attach to brackets and runners with 1⅝″ Type S Screws spaced 16″ o.c. Install hexagonal mesh over middle layer at beam soffit. Extend mesh 1½″ up sides of beam and hold in place with 1⅝″ screws used to attach middle layer. Apply face layer over middle layer and wire mesh, and fasten to brackets and runners with 2¼″ Type S Screws spaced 8″ o.c. Apply all layers so soffit panels support vertical side boards.

Finishing Construction—Apply corner bead to bottom outside corners of face layers and finish with joint treatment as directed in Chapter 2.

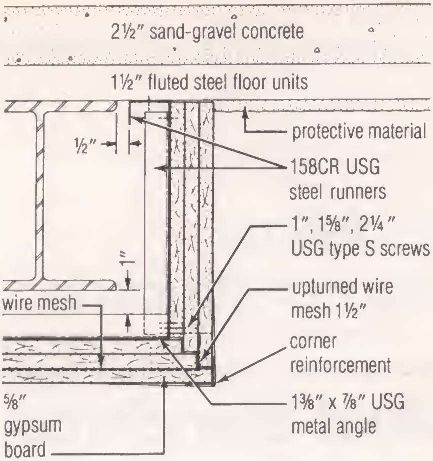
UL Design N501 (beam only)



UL Design N502 (beam only)

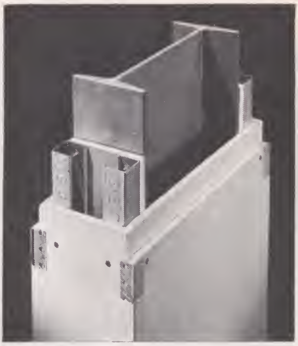


UL Design N505 (beam only)



Column Fire Protection

Steel column fire protection with lightweight and compact gypsum board enclosures offers fire ratings of 2, 3 or 4 hours depending upon construction. The board is held in place by a combination of wire, screws, and steel studs. All attachments are mechanical—there's no waiting for adhesives to dry.



chapter 4

conventional plaster construction

product standards

quality: secret of success

It is universally acknowledged that a completed plaster job can be no better than the basecoat or finish materials used and the base to which they are applied. In the years since the Company's formation in 1902, United States Gypsum plastering products have gained their superiority on one basis: *performance*.

This record of performance extends through the complete U.S.G. line—broadest in the industry—of plaster and lime products, plaster bases and accessories, designed by U.S.G. to *work together* in a wide range of wall and ceiling systems.

Described on the following pages are the basic materials recommended by United States Gypsum Company for quality plaster walls and ceilings. They are designed to meet the essential requirements of function, economy and speed of installation.

The U.S.G. trademark on a product is your assurance of consistent high quality and proven performance to meet your construction needs.

United States Gypsum employs technical sales representatives to consult with contractors, architects and dealers on plastering materials, systems and special job conditions. They may be reached through the nearest U.S.G. Sales Office or by writing to United States Gypsum, Dept. 147-5, 101 S. Wacker Dr., Chicago, Ill. 60606.

Plaster Bases

Proper use of U.S.G. plaster bases and plasters provides the secure bond necessary in order to develop strength and resistance to abuse and cracking. These characteristics are common to both metal lath and gypsum plaster bases.

gypsum plaster bases

ROCKLATH Plaster Base is a gypsum lath providing a rigid, fire-resistant base for the economical application of gypsum plasters. ROCKLATH Base requires about 45% less basecoat plaster than with metal lath.

The gypsum core of this lath is faced with multilayer laminated paper formulated by a U.S.G. process to provide proper absorption, check plaster slide and resist lath sag. As illustrated, the three outer layers (1) are made highly absorbent to *draw* moisture from the plaster mix uniformly and quickly so that the plaster takes on anti-slump strength before it can slide; the inner layers (2) are chemically treated to form a barrier *against* moisture penetration, thus reduce softening of the gypsum core and consequent sag after board is in place. Face paper is folded around the long edges and the ends are square-cut.

ROCKLATH multi-ply face paper

ROCKLATH Base complies with ASTM C37, and Federal Specification SS-L-30D Type I. Other features are:

Fire Resistance—When used with gypsum plaster, gypsum plaster bases provide assemblies with fire ratings of up to 2 hrs.

for partitions, ceilings and column fireproofing. (See Plaster Systems in Chapter 6.)

Strength—When securely attached, gypsum plaster bases add lateral stability to the assembly.

Sound Resistance—Partitions faced with gypsum plaster bases and plaster on both sides have excellent resistance to sound transmission; resilient attachment further improves ratings, makes assemblies suitable for party walls.

Bonding—Gypsum plaster bonds to these gypsum plaster bases with a safety factor far higher than required to meet usual construction standards.

Durability—Not harmfully affected by decay, dry rot, or normal moisture; will not attract vermin.

General Limitations: (1) Maximum frame spacing is dependent on thickness and type of lath used; (2) To be used with gypsum plaster only. Bond between lime or portland cement plaster and ROCKLATH Base is inadequate; (3) Should not be used in areas that are exposed to excessive moisture for extended periods or as a backing for ceramic tile or other similar surfacing materials commonly used in wet areas; USG Galvanized Metal Lath and portland cement-lime plaster are recommended; (4) The size and absorption of ROCKLATH Base make it unsuitable for veneer plasters and finishes.

Note: Gypsum basecoat plasters have slightly greater dimensional stability than gypsum lath. Therefore, the stability of the lath would govern in design problems. Refer to Appendix for coefficients of expansion, and data on drying shrinkage.

ROCKLATH Plaster Bases

Available in ⅜″ and ½″ thicknesses and in three different products for specific uses:

Regular ROCKLATH Plaster Base—Used for nail or staple application to wood; clip attachment to wood framing, steel studs and suspended metal grillage; screw attachment to USG Steel Studs and Metal Furring Channels.

ROCKLATH FIRECODE Plaster Base—A gypsum lath which combines all the advantages of Regular ROCKLATH Base with additional resistance to fire exposure—the result of a specially formulated core containing special mineral materials.

Foil-Back ROCKLATH Plaster Base—Made in the same sizes as

Regular ROCKLATH, but has bright aluminum foil laminated to the back side. This creates an effective vapor retarder at no additional labor cost. Its permeance of 0.6 perms is well below the 1.00 perm limit permissible under HUD requirements. The emittance value for aluminum foil is 0.05. To utilize this data for determining thermal insulating value of the system when plaster base is installed facing a concealed air space of ½″ minimum, refer to ASHRAE *Handbook of Fundamentals*. Corrosion and normal dust accumulation have little effect on vapor retarder characteristics of Foil-Back ROCKLATH BASE.

Note: See Appendix for Thermal Resistance Values (R).

Specifications—ROCKLATH Plaster Bases

ROCKLATH product	thickness		width		length		pc/bdl	approx. wt.	
	in	mm	in	mm	in	m		lb/ft²	kg/m²
Regular	⅜	5.9	16	406	48	1.2	6	1.4	6.8
Regular	½	12.7	16	406	48	1.2	4	1.8	8.8
Regular	½	12.7	24	610	96	2.4	2	1.8	8.8
FIRECODE	⅜	5.9	16	406	48	1.2	6	1.4	6.8

metal lath

USG Metal Lath—Sheet steel that has been slit and expanded to form a multitude of small mesh openings. It is made in Diamond Mesh, Riblath and Stuccomesh types and in two different weights for most types. Manufactured from steel protected by a coating of black asphaltum paint. Diamond Mesh and ⅜″ Riblath are also available in galvanized steel. Comply with Federal Specification QQ-L-101C.

Ends of bundles of USG Metal Lath are spray-painted in different colors for various weights, thus simplifying stocking and handling. All 3.4-lb. lath is painted *red;* 2.5-lb. diamond mesh and 2.75-lb. ⅛″ riblath are *white;* 4.0-lb. ⅜″ riblath is *yellow.*

In addition, USG Metal Lath offers these features:

Strength—Metal lath embedded within the plaster provides reinforcement.

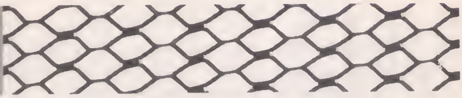
Flexibility—Readily shaped to ornamental contours to a degree not possible with other plaster bases.

Fire Resistance—When used with gypsum plaster, metal lath provides excellent fire-resistant construction; up to 2 hrs. for partitions and 4 hrs. for ceilings and column fireproofing (See Plaster Systems, Chapter 6.)

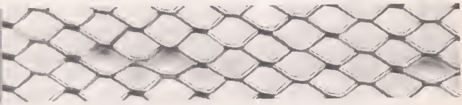
Security—Metal lath and plaster surfaces are extremely difficult to penetrate, provide excellent protection against break-through.

Available in following types and styles:

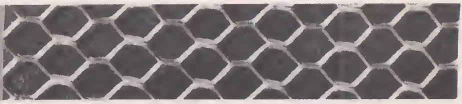
USG Junior Diamond Mesh Lath



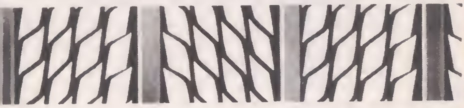
USG Self-Furring Diamond Mesh Lath



USG Paper-back Lath



USG 4-Mesh Z-Riblath



USG 3/8" Riblath

USG Expanded Metal Stuccomesh

USG Junior Diamond Mesh Lath—A small diamond mesh metal plaster base (approx. 11,000 meshes per sq. yd.). A general all-purpose lath, best for ornamental, contour plastering. The small mesh openings conserve plaster and reduce droppings. Also available in *self-furring* type having ¼" "dimple" indentations spaced 1½" o.c. each way, for use as exterior stucco base, column fireproofing and for replastering over old surfaces.

USG Paper-back Lath—Asphalt paper backed Junior Diamond Mesh Lath available painted or galvanized. Asphalt impregnated paper is factory-bonded to the back. Paper is vapor permeable. Meets Federal Specification UU-B-790a, Type I, Grade D, Style 2.

Asphalt-backed painted lath is recommended for lath and plaster back-up of interior tile work and other inside work.

Asphalt-backed galvanized lath is a recommended base and reinforcement for exterior wall construction, including stucco and other machine or hand applied exterior surfacing materials.

USG 4-Mesh Z-Riblath—A "flat rib" type of lath with smaller mesh openings, suitable for "double-up" plastering. More rigid

Specifications—USG Metal Lath

product	approx. wt.		finish		size				packaging (bundle)			
					width		length		color code	pcs	quantity	
	lb/yd²	kg/m²	paint	galv.	in	mm	in	m			yd²	m²
Diam. Mesh - Regular	2.5	1.4	x	x	27	686	96	2.4	White	10	20	16.7
	3.4	1.8	x	x	27	686	96	2.4	Red	10	20	16.7
- Self-Furring	2.5	1.4	x	x	27	686	96	2.4	White	5	10	8.4
	3.4	1.8	x	x	27	686	96	2.4	Red	5	10	8.4
- Asphalt Paper-backed	2.5[1]	1.4	x	x	27	686	96	2.4	White	10	20	16.7
	3.4[1]	1.8	x	x	27	686	96	2.4	Red	10	20	16.7
⅜" (9.5mm) Riblath	3.4	1.8	x	x	27	686	96	2.4	Red	10	20	16.7
4-Mesh Z-Riblath	2.75	1.5	x		27	686	96	2.4	White	10	20	16.7
	3.4	1.8	x		27	686	96	2.4	Red	10	20	16.7
Stuccomesh	3.6	2.0	x		48	1219	99	2.5	—	10	36⅔	30.7

[1]Add 0.3 lbs/yd for weight of paper.

than diamond mesh, excellent as nail-on lath, and for tie-on work on flat ceilings. Not recommended for contour lathing.

USG ⅜″ Riblath—A herringbone mesh pattern with ⅜″ V-shaped ribs running lengthwise of the sheet at 4½″ intervals, with inverted intermediate 3⁄16″ ribs. The heavy ribs provide exceptional rigidity. Used when supports are spaced more than 16″ o.c. and not more than 24″, and for 2″ solid studless metal lath and plaster partitions. Also used as a centering lath for concrete floor and roof slabs. Unsuitable for contour plastering. Min. ground thickness must be 1″.

USG Expanded Metal Stuccomesh—A 1⅜″×3⅛″ diamond-mesh pattern designed as a base for exterior stucco, hand or pump-applied. It should be applied with 1½″ galvanized self-furring nails; when used over sheathing other than wood, longer nails should provide min. penetration of 1⅛″ into studs.

Limitation: these metal products should not be used with magnesium oxychloride cement stucco or portland cement stucco containing calcium chloride additives.

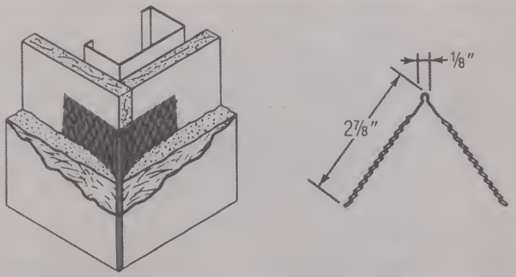
Trim Accessories

USG Corner Beads should be used on all external plaster corners to provide protection, true and straight corners, and grounds for plastering; USG Casing Beads, around wall openings and at intersections of plaster with other finishes. Both products are made from galvanized steel.

Limitation: painted steel accessories are recommended for interior use only. For exterior application and where corrosion due to high humidity and/or saline content of aggregates is possible, the use of galvanized or zinc alloy accessories is required. Should not be used with magnesium oxychloride cement stucco or portland cement stucco containing calcium chloride additives.

corner and casing beads

1-A Expanded Corner Bead—Has wide expanded flanges that are easily flexed. Preferred for irregular corners. Provides increased reinforcement close to nose of bead.

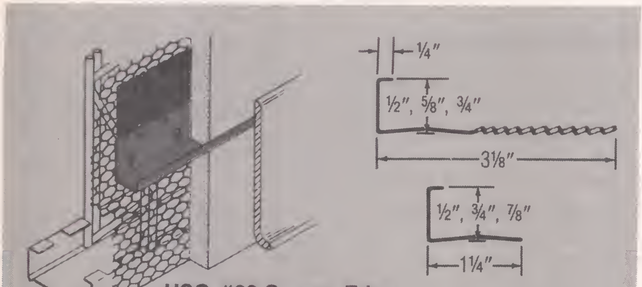


USG 1-A Expanded Corner Bead

4-A Flexible Corner Bead—A general-purpose corner bead, economical and most generally used. By snipping flanges, this bead may be bent to any curved design (for archways, etc.)

X2 Corner Bead—Has full 3¼″ flanges easily adjusted for plaster depth on columns. Ideal for finishing corners of structural tile and rough masonry. Has perforated stiffening ribs along expanded flange.

USG Casing Beads—Used as a plaster stop and exposed to eliminate the need for wood trim around window and door openings; also recommended at junction or intersection of plaster and other wall or ceiling finishes and as a screed as illustrated here. May be used with USG Metal Lath, ROCKLATH Plaster Base, or masonry construction. In order to insure proper grounds for plastering, ¾″ casing beads are recommended for use with metal lath, ⅝″ beads with all masonry units, ⅞″ beads when flange is applied *under* gypsum plaster base, ½″ beads when flange is applied *over* gypsum base. Available in galvanized steel or zinc alloy for exterior applications.



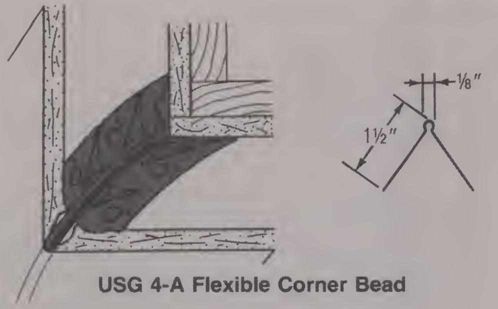
USG #66 Square Edge Casing Beads (expanded or short flange)

cornerite and striplath

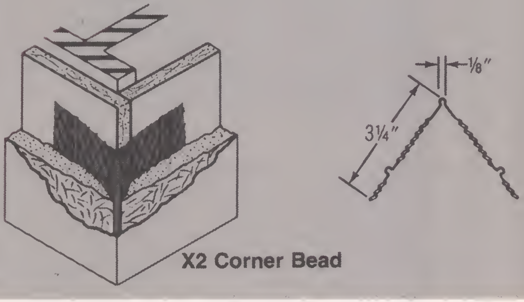
These U.S.G. products are strips of painted Diamond Mesh Lath used as reinforcement. **Cornerite,** bent lengthwise in the center to form a 100° angle, should be used in all internal plaster angles where metal lath is not lapped or carried around; over gypsum lath, anchored to the lath, and over internal angles of masonry constructions. Also used in the "Floating Angle" method of applying gypsum lath to wood framing in order to reduce plaster cracking. **Striplath** is a similar flat strip, used as a plaster reinforcement over joints of gypsum lath and where dissimilar bases join; also to span pipe chases, and as reinforcement of headers over openings.

control joints

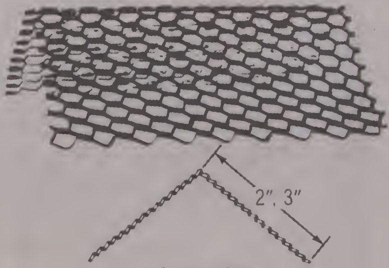
USG Control Joint—Designed to relieve stresses of both expansion and contraction in large plastered areas. Made from roll-formed zinc alloy, it is resistant to corrosion in both interior and



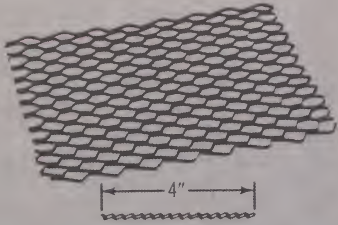
USG 4-A Flexible Corner Bead



X2 Corner Bead



Cornerite



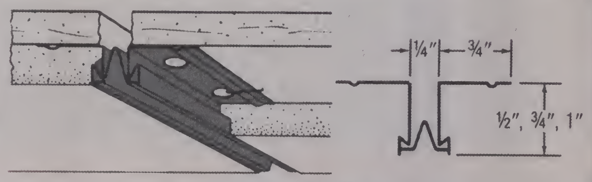
Striplath

Specifications—Trim Accessories

product	depth or grounds		flange width		finish	length[1]			pcs. per ctn.	approx. weight	
	in	mm	in	mm		7′	8′	10′		lb/1000 ft	kg/100m
USG 1-A Expanded Corner Bead			2⅞	73.0	Galv.		x	x	40 30	195 195	29 29
USG 4-A Flexible Corner Bead			1½	38.1	Galv.		x	x	30	179	27
USG X2 Corner Bead			3¼	82.6	Galv.		x	x	40 30	253	38 38
USG #66-Square Expanded Flange Casing Bead[2]	½ ⅝ ¾	12.7 15.9 19.1	3⅛ 3⅛ 3⅛	79.4 79.4 79.4	Galv. Galv. Galv.	 x	x x	x x x	8′-40, 10′-30 30 7′,8′,-40 10′-30	213 241 255	32 36 38
USG #66-Square Short Flange Casing Bead	½ ¾ ⅞	12.7 19.1 22.2	1¼ 1¼ 1¼	31.7 31.7 31.7	Galv. Galv. Galv.			x x x	30 30 30	178 202 212	26 30 32
USG Cornerite			2 3	50.8 76.2	Paint or Galv. Paint or Galv.		x x		75 75	90 132	13 20
USG Striplath			4 (Reg.)	101.6	Paint		x		75	90	13
USG Control Joint #50 #75 #100	½ ¾ 1	12.7 19.1 25.4	¾ ¾ ¾	22.2 22.2 22.2	Zinc Alloy Zinc Alloy Zinc Alloy			x x x	25 25 25	172 192 216	26 29 32

[1]Metric lengths: 7=2.1m, 8=2.4m, 10=3.0m. [2]Available in zinc, special order only.

exterior uses with gypsum or portland cement plaster. An open slot, ¼″ wide and ½″ deep, is protected with plastic tape which is removed after plastering is completed. The short flanges are perforated for keying and attachment by wire-tying to metal lath or by stapling to gypsum lath. Thus the plaster is key-locked to the control joint, which not only provides plastering grounds but can also be used to create decorative panel designs. Sizes and grounds: **No. 50,** ½″; **No. 75,** ¾″; **No. 100,** 1″ (for uses such as exterior stucco).



USG Control Joint

Limitation: where sound and/or fire ratings are prime considerations, adequate protection must be provided behind the control joint. Functions only with transverse stresses. Should not be used with magnesium oxychloride cement stucco or portland cement stucco containing calcium chloride additives.

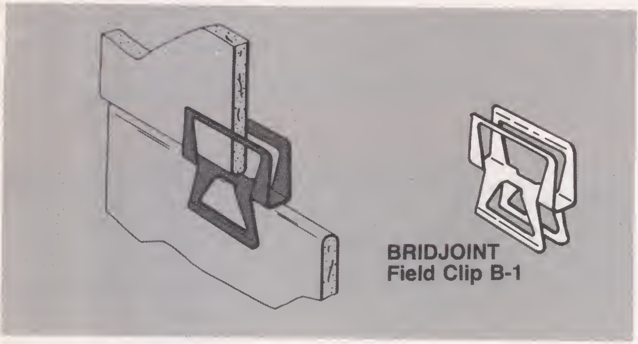
For exterior application, back control joints with 2″ wide butyl tape applied to the sheathing. Install joints with flanges under self-furring lath and attach with Bostitch 9⁄16″ "G" staples or equal, spaced 6″ apart on each side. Break supporting members, sheathing and metal lath behind control joints. When vertical and horizontal joints intersect, vertical joint should be continuous; horizontal joint should abut it. Apply sealant at all splices, intersections and terminals.

Clips and Screws

A complete line of specially formed steel clips and self-drilling screws is available to provide positive attachment and rapid erection of U.S.G. gypsum plaster bases and metal lath.

Clips provide rigid alignment of gypsum plaster base in wall and ceiling systems; attachment and support of entire lath area in other systems. Resilient clips are used for floating attachment of gypsum lath, affording protection against plaster cracking due to structural movement plus increased sound resistance.

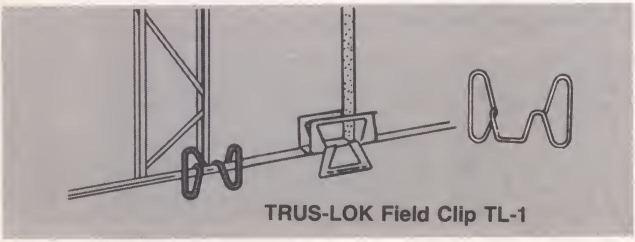
BRIDJOINT Field Clip B-1—Used to support and align end joints which do not fall opposite structural members; designed for use with 3/8″ ROCKLATH Base.



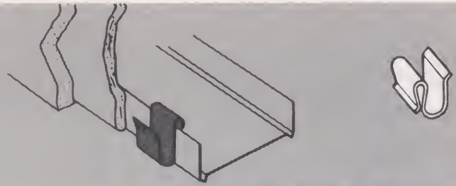
BRACE-TITE Field Clip BT-1—Used for suspended ceilings. Provides support across full width of lath. For use with standard 3/4″ cold-rolled channels.

BRACE-TITE Starter Clip BT-1—Used in conjunction with BT-1 Field Clip to start first course of lath.

TRUS-LOK Field Clip TL-1—Attaches 3/8″ ROCKLATH Plaster Base to TRUSSTEEL Studs.

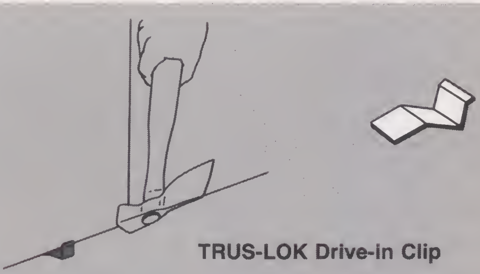


TRUS-LOK Starter Clip TL-2—Used with TL-1 Clips, MS-1 Clips and runner track to start first course of lath.



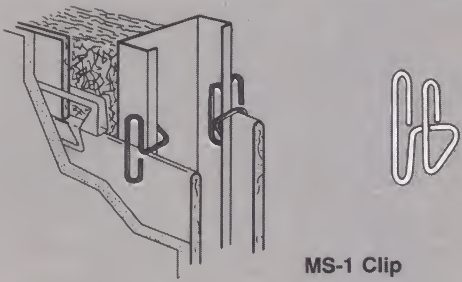
TRUS-LOK Starter Clip TL-2

TRUS-LOK Drive-In Clip—Used to anchor (1) bottom course of lath in direct attachment to TRUSSTEEL Studs, and (2) top course of lath in partitions to underside of monolithic concrete flat slab or concrete joist filler construction; also as starter-finisher clip with Steel Stud-ROCKLATH Plaster Base Partition.



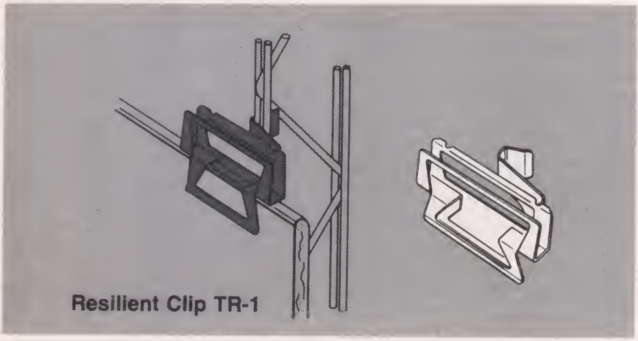
TRUS-LOK Drive-in Clip

MS-1 Clip—Serves for direct attachment of ⅜″ ROCKLATH Base to channel-type USG Steel Studs.



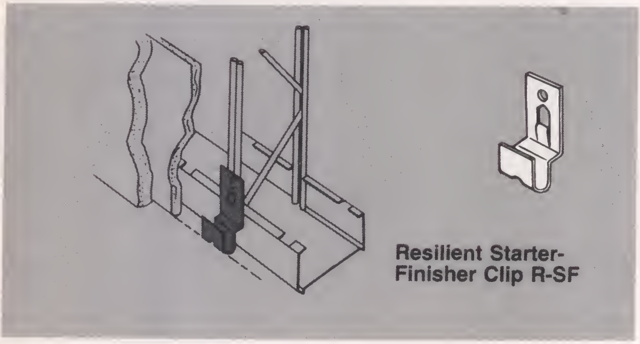
MS-1 Clip

Resilient Clip TR-1—Attaches 3/8″ ROCKLATH Base to TRUSSTEEL Studs spaced 16″ o.c., furs lath 3/8″ from stud face.



Resilient Clip TR-1

Resilient Starter-Finisher Clip R-SF—Used with starting and last courses of resiliently attached ROCKLATH Plaster Base on wood studs or TRUSSTEEL Snap-in Runner Track.



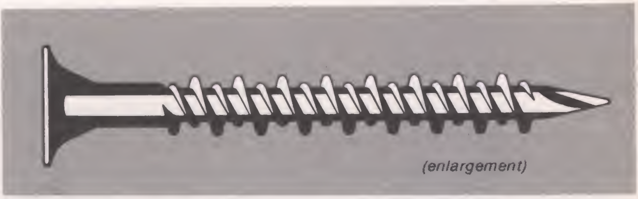
Resilient Starter-Finisher Clip R-SF

Specifications—Lath Attachment Clips

product	clips per 100 yd² (84m²) lath	shipping unit (pc)	wt/1000 pc	
			lb	kg
BRIDJOINT Clip B-1	350	500	19	8.6
BRACE-TITE Field Clip BT-1	550-600(2) 750-800(3)	500	28	12.7
BRACE-TITE Starter Clip BT-1	(4)	500	11	5.0
TRUS-LOK Field Clip TL-1	550-600	1000	26	11.8
TRUS-LOK Starter Clip TL-2	(5)	500	8	3.6
TRUS-LOK Drive-In Clip	(5)	500	11	5.0
MS-1 Clip	550-600	1000	22	10.0
Resilient Clip TR-1	550-600	250	17	7.7
Resil. Starter-Finisher Clip R-SF	(5)	250	6	2.7

(1)Quantity based on stud spacing of 16″ o.c. unless otherwise noted. (2)3/4″ chan. frame 16″ o.c. (3)3/4″ chan. frame 12″ o.c. (4)1 clip at each chan. frame and starter lath juncture. (5)1 ea. 16″ at bottom edge of first course—may be used on top edge of last course—adaptable to varying thicknesses of lath.

USG Screws—The result of continuing development aimed at producing the best possible attachment of gypsum boards to steel, wood or gypsum supports simply and quickly. A complete line of self-drilling, self-tapping steel screws is available to improve construction systems and simplify installation methods. All screws are highly corrosion-resistant and have a Phillips head recess for rapid installation with a special bit and power-driven screwgun. For complete data and Screw Selector Guide, see Chapter 1.



Bugle head, high and low threads, slotted point of USG Screws.

Economical SUPER-TITE Screws with specially designed drill point for steel studs.

Steel Framing Components

U.S.G. leads the industry in the development and acceptance of structural components for plastering systems. They offer the advantages of light weight, low material cost and quick erection, superior strength, and versatility in meeting job requirements. All are noncombustible, made from cold-rolled or galvanized steel or rods.

TRUSSTEEL Studs—The original open-truss design studs for the erection of hollow, fire-resistant partitions. The strongest non-load bearing studs on the market, they are formed from cold-drawn No. 7-ga. steel wire rods with a tensile strength of 90,000 psi—substantially higher than the hot-rolled sheets from which pressed metal and edge angle studs are formed.

Made with a continuous diagonal wire web welded to double-wire flanges, TRUSSTEEL Studs are fabricated in five stud widths, factory-cut to job lengths. The open-web design readily accommodates pipes, conduits and ducts without impairing the strength of the partition assembly. This engineered member, together with its accessories, provides a framework for quick direct or resilient attachment of metal or gypsum lath.

TRUSSTEEL Snap-in Runner Track—Used in anchoring the TRUSSTEEL Stud Partition to the floor. Attachment of stud to

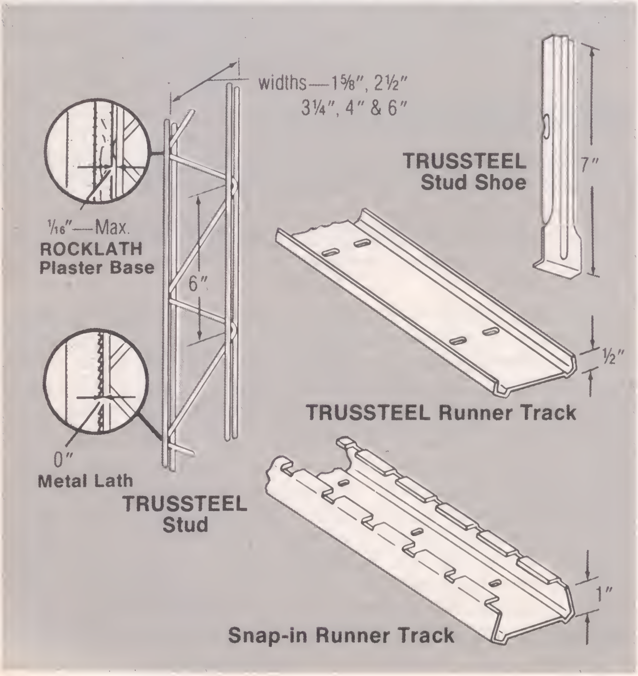
track is by a snap-in feature, eliminating the need for stud shoes. When the track serves as a ceiling runner, however, stud shoes are used if a fire rating is required. Available for all except the 6″ width of TRUSSTEEL Studs.

TRUSSTEEL Runner Track—Used along with TRUSSTEEL Stud Shoes to anchor the partition to the floor or ceiling, particularly where there is considerable floor-to-ceiling height variation. Available for all widths of TRUSSTEEL Studs. Where top track is attached to suspended or furred framing, 1″ no. 12 flathead screws are used to anchor top course of lath into web wires of studs.

TRUSSTEEL Stud Shoes—7″ long, are used for connecting studs to regular track and permit up to a 4″ adjustment in partition height. Available in galvanized steel for standard interior construction.

USG Steel Studs and Runners—Channel-shape and roll-formed from galvanized or aluminized steel, are used in non-load and load-bearing interior partition and exterior curtain wall systems. Limited chaseways are provided by punchouts in the web. Assemblies using these studs are low in cost with excellent sound and fire-resistance characteristics. Available in various styles and widths to meet functional requirements outlined below:

Interior Partitions, Ceilings, Column Fireproofing—ST and CWS stud styles in five widths—1⅝″, 2½″, 3⅝″, 4″, 6″—and 8 to 16-ft. lengths. Runners in stud widths, 10-ft. length.



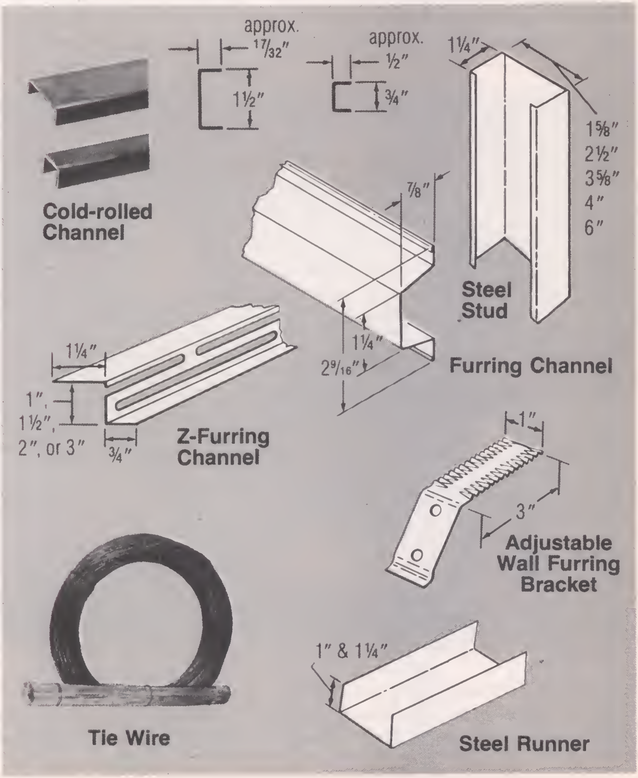
Exterior Curtain Walls—Studs are available in various styles to meet height requirements and in six widths—2½", 3½", 3⅝", 4", 5½", 6"—lengths up to 28 ft. Runners in stud widths (with 1¼" unhemmed leg), 10-ft. length.

Load-bearing Construction—Studs are available in two styles for framing load-bearing interior and exterior walls and non-load-bearing exterior curtain walls. *SJ style,* with stiffened flanges, comes in 3½", 3⅝", 4", 5½", 6", 8" sizes and *CS style* in 3½", 3⅝", 4", 6" sizes with unstiffened flanges and less load capacity for greater economy in selecting members. Factory-cut in lengths up to 30 ft. Runners in stud widths (with 1" or 1¼" unhemmed legs), 10-ft. length.

For complete data on USG Steel Studs and Runners see Chapter 1; for installation, see Chapter 2.

USG Cold-rolled Channels—Formed from 16-ga. steel, black asphaltum painted or galvanized; used for furring, suspended ceilings, partitions, and ornamental lathing. Sizes: ¾", 1½".

USG Metal Furring Channels—Roll-formed, hat-shaped section of galvanized steel. This 25-ga. channel may be attached with furring clips or tie wire to the 1½" main carrying channel and spaced 16" o.c. for economical screw attachment of ROCKLATH



Specifications—Structural Accessories

product		size		lengths		shipping unit	weight			
							unit			
		in	mm	ft	m		lb	kg	lb/1000 ft	kg/100 m
TRUSSTEEL Studs	(1)	1⅝	41.3	Made to Order		10 pc	—	—	440	65
	(1)	2½	63.5				—	—	455	68
	(1)	3¼	82.6				—	—	470	70
	(1)	4	101.6				—	—	485	72
	(1)	6	152.4				—	—	515	77
TRUSSTEEL Snap-In Runner Track	(2)	1⅝	41.3	10	3.05	10 pc	30	14	295	44
	(2)	2½	63.5				36	16	355	53
	(2)	3¼	82.6				42	19	415	62
	(2)	4	101.6				47	21	470	70
TRUSSTEEL Runner Track	(2)	1⅝	41.3	10	3.05	10 pc	20	9	200	30
	(2)	2½	63.5				27	12	265	39
	(2)	3¼	82.6				33	15	325	48
	(2)	4	101.6				38	17	375	56
	(2)	6	152.4				53	24	525	78
TRUSSTEEL Stud Shoes	(2)	24 ga	0.6	—	—	500 pc	40	18	—	—
USG Furring Channel	(2)	25 ga	0.5	12	3.66	10 pc	34	15	285	42
USG Furring Channel Clips	(2)	1½	38.1	—	—	500 pc	20	9	—	—
USG Cold-rolled Channel	(1) & (2)	¾	19.1	16, 20	4.88, 6.10	20 pc	96, 120	44, 54	300	45
		1½	38.1	16, 20	4.88, 6.10	10 pc	80, 100	36, 45	500	74
USG Tie Wire/Hanger Wire	(2)	18 ga	1.2	8310	2533	Coil	50	23	—	—
	(2)	18 ga	1.2	4	1.22	Hank (4128 ft)	25	11	—	—
	(2)	8 ga	4.2	730	223	Coil	50	23	—	—
USG Adj. Furring Bracket	(2)	20 ga	0.9	—	—	500 pc	29	13	—	—

Notes: (1) Painted; (2) Galvanized.

Base as a base for either adhesively applied acoustical tile or a basecoat plaster; 4-ft. span max. The furring channel also provides noncombustible furring for exterior walls and may be spaced up to 24″ o.c. Face width 1¼″, depth ⅞″.

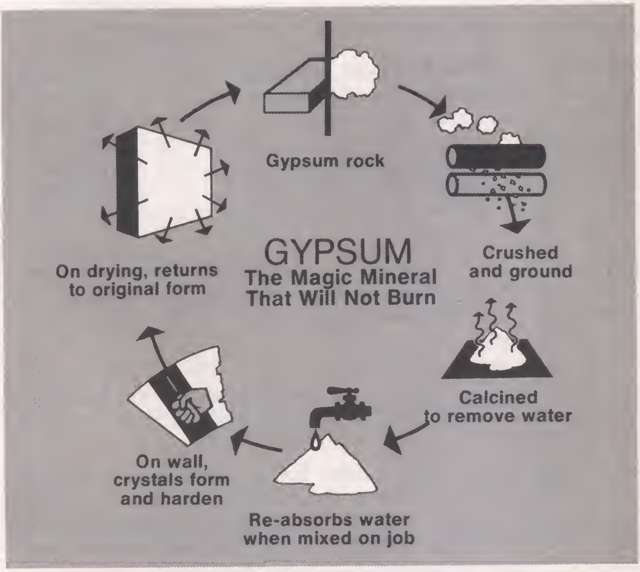
Note: See Chapter 1 for data on USG Z-Furring Channels.

USG Adjustable Wall Furring Brackets—Used for attaching ¾″ furring channels to exterior masonry walls. Made of galvanized steel with corrugated edges, brackets are attached to masonry and act as supports for horizontal channels 24″ o.c. in braced furring systems.

USG Tie Wire—18-ga. galvanized soft annealed wire for tying metal lath to channels and furring to runner channels; also 8-ga. **Hanger Wire** for suspended ceiling channel runners when spaced not more than 4 ft. o.c.

Plasters

The main ingredient of all gypsum plasters is gypsum rock—hydrous calcium sulfate, which has a water content of about 20% in chemical combination. During processing, about ¾ of this chemically combined water is removed from the gypsum rock by means of a controlled calcination process. When water is added at the job, the material crystallizes (sets), reverting to its original chemical composition.



U.S.G. gypsum plasters are specifically formulated to control setting time and provide other important characteristics. These depend upon the intended use and method of application, the climatic conditions of the area and job conditions.

Basecoat Plasters

For the beauty and durability of which plaster is capable, certain requirements should be followed as to the number of coats applied. Three-coat work is necessary on all metal lath and on edge clip-supported gypsum lath used in ceilings; three-coat work is desirable on all gypsum lath; two-coat work is acceptable on unperforated gypsum lath when properly supported and on rough concrete block, clay tile, or porous brick. Outside masonry should be furred prior to plastering to prevent seepage and condensation.

In preparing for plastering, consideration should be given to the selection of materials not only for compatibility but for the quality of the structure to be plastered. It is wise to upgrade plastering specifications when possible.

RED TOP Gypsum Plaster—Preferred for its low cost and excellent workability, must be job-aggregated. Three types: *Regular*—for sand aggregate, hand application; *LW*—for lightweight aggregate, hand application; *Machine Application*—for sand or lightweight aggregate; perlite aggregate not recommended when vertical lift exceeds 30 ft. or hose length is over 150 ft. Meets ASTM C28 and Federal Specification SS-P-00402B, Type II. Available in 100-lb. bags.

RED TOP Wood Fiber Plaster—Contains selected wood fiber, and can be used with the addition of water only. When used over masonry bases or for machine application, 1 cu. ft. of sand per 100 lb. of plaster must be added. When used as a scratch or brown coat, 1 cu. ft. of sand should be added.

RED TOP Wood Fiber Plaster can be applied to all standard lath and masonry surfaces and is recommended as a scratch coat for metal lath.

Wood Fiber Plaster, neat, weighs approx. ¼ less than a sanded gypsum basecoat, and generally provides greater fire resistance than normally sanded gypsum plaster at a slightly higher cost. Complies with ASTM C28 and Federal Specification SS-P-00402B, Type III. Available in 100-lb. bags.

RED TOP Two-Purpose Plaster—Suitable for machine or hand application, reduces inventory requirements. Must be job-aggregated; perlite aggregate not recommended when vertical lift exceeds 30 ft. or hose length is over 150 ft. Meets ASTM C28

Gypsum Basecoat Plasters—Technical Data

plaster product	mix	ratio: aggregate (vol.)/ basecoat (wt.)		approx. compressive strength dry[1]		approx. coverage per ton of gypsum basecoat[2]					
						gypsum lath		metal lath		unit masonry	
		ft³/100 lb	m³/ton[5]	lb/in² (psi)	MPa[4]	yd²/ton	m²/ton[5]	yd²/ton	m²/ton	yd²/ton	m²/ton[5]
STRUCTO-LITE	regular	—	—	700	4.82	140	129	75[3]	69[3]	135	124
RED TOP Wood Fiber	neat	—	—	1750	12.06			50	46		
RED TOP Wood Fiber	sand	1.0	0.62	1400	9.65	135	124	70	64	105	97
STRUCTO-BASE	sand	2.0	1.25	2800 min.	19.30						
	sand	2.5	1.56	1900 min.	13.10	165	152	100	92	165	152
	sand	3.0	1.87	1400 min.	9.65						
RED TOP Gypsum and Two-Purpose Plasters	sand	2.0	1.25	875	6.00						
	sand	2.5	1.56	750	5.17	210	193	115	106	185	170
	sand	3.0	1.87	650	4.48						
	perlite	2.0	1.25	700	4.82	185	170	90	83	150	138
	perlite	3.0	1.87	525	3.62						
	vermiculite	2.0	1.25	465	3.21	180	165	—	—	165	152
	vermiculite	3.0	1.87	290	2.00						

(1)Average laboratory results when tested in accordance with ASTM C472. Figures may vary slightly for products from individual plants. (2)Grounds (including finish coat): gypsum lath—½″ (face of lath), metal lath—¾″ (back of lath), unit masonry—⅝″. (3)Lightweight aggregated plasters are not recommended over metal lath when the finish coat is to be smooth troweled. (4)Megapascals (MN/m²). (5)Metric ton.

Machine application of basecoat plaster

and Federal Specification SS-P-00402B, Type II. Available in 100-lb. bags.

STRUCTO-LITE Gypsum Plaster—Contains mill-mixed perlite aggregate, is preferred in cold weather when aggregate may freeze, or when suitable aggregate is not readily available. Lighter weight and greater insulation value than sanded basecoats. Three types: *Regular*—for gypsum or metal lath; *Masonry*—for high-suction unit masonry; *Type S*—for specific UL-listed assemblies. Not recommended over metal lath when smooth-trowel lime finish is used or machine application when vertical lift exceeds 30 ft. or hose length is over 150 ft. Meets ASTM C28 and Federal Specification SS-P-00402B, Type I. Available in 80-lb. bags.

STRUCTO-BASE Gypsum Plaster—Develops higher strength than conventional plasters. Ideal for handball courts, hospital corridors, schools, etc. requiring high-strength basecoat. Superior as sanded scratch and brown coat over metal lath. Meets ASTM C28 and Federal Specification SS-P-00402B, Type II. Available in 100-lb. bags.

Portland Cement-Lime Plaster—This mix is used for interior applications where high-moisture conditions exist, or for exterior stucco. Prepared as follows:

Job-mixed Stucco—Mix BONDCRETE or MORTASEAL Mason's Lime with portland cement and sand in accordance with ANSI A42.2, Type L. Suggested proportions: *scratch coat*—1 bag portland cement, ¾ to 1 bag lime, 5 to 6 cu. ft. sand; *brown coat*—1 bag portland cement, 1 bag lime, 6 to 7 cu. ft. sand; *finish*—1 bag portland cement, 2 bags lime, 7 to 10 cu. ft. sand.

Prepared Finish—ORIENTAL Exterior Finish Stucco (see page 253).

Limitations of portland cement plaster: (1) Scratch, brown and finish coats require curing with water after set; (2) Must not be

applied directly to smooth, dense surfaces, gypsum lath or gypsum block. Self-furring metal lath must be secured to such surfaces before plaster is applied; (3) Control joints should be provided to compensate for shrinkage during drying; (4) A Keenes cement-lime putty finish must never be used over a portland cement basecoat.

Gauging Plasters

Lime, when used alone as a finish plaster, does not set, is subject to shrinkage when drying, and lacks a hard finish. Gauging plaster is blended into the lime putty in the proper proportions to provide controlled set, early hardness and strength, and to prevent shrinkage cracks.

Gauging plasters are carefully ground and screened to proper particle sizes to make the plasters quick-soaking and easily blended with lime putty.

High-strength RED TOP Keenes Cement and STRUCTO-GAUGE Gauging Plaster are to be used only over sanded or wood fiber basecoat plasters. Over lightweight aggregated basecoats, use white or regular gauging plaster that is properly aggregated.

CHAMPION and STAR Gauging Plasters—Selected for white smooth-trowel or sand-float lime-putty finishes. Effectively resist cracking, provide hardness and abrasion resistance required for normal interior walls and ceilings. Applied over a gypsum basecoat. Job-aggregated, sand-float finish may be job-colored. Available in *Regular,* unaggregated; *"Quality"*, with perlite fines for lightweight-aggregated basecoats. When mixed with recommended proportions of lime putty, CHAMPION Plaster sets in 20–30 min.; STAR Plaster in 40–60 min. Meet ASTM C28 and Federal Specification SS-P-00402B, Type V. Available in 50- and 100-lb. bags.

RED TOP Gauging Plaster—Blends easily with lime putty for durable smooth-trowel or sand-float finishes in residential construction. Provides high strength, hardness and abrasion resistance superior to many other surfaces. Usually darker in color than CHAMPION and STAR Gauging Plaster; easily painted or decorated. Applied over a gypsum basecoat. Available in *Regular,* unaggregated; *"Quality",* with perlite fines for lightweight-aggregated basecoats. Two types: *Quick Set* (30–40 min); *Slow Set* (50–70 min.). Meets ASTM C28 and Federal Specification SS-P-00402B, Type V. Available in 100-lb. bags.

STRUCTO-GAUGE Gauging Plaster—Mixed with lime putty, produces high-strength, durable white smooth-trowel finish for high-traffic areas. Excellent hardness and abrasion resistance to withstand abuse. Faster and easier to apply than Keenes Cement. Used over high-strength wood fiber or sanded gypsum basecoats. Not for use over lightweight-aggregated or portland cement basecoats or masonry. Two types: *Slow Set* (60–75 min.) for regular sanded basecoats; *Quick Set* (30–40 min.) for low-suction veneer basecoats. Meets ASTM C28 and Federal Specification SS-P-00402B, Type V. (5,000 lb./in.^{2} compressive strength when tested in accordance with ASTM C472.) Available in 100-lb. bags.

RED TOP Keenes Cement—High-strength, white plaster mixed with lime putty, provides durable, highly crack-resistant sand-float finish for schools, hospitals, other hard-wear surfaces. As a smooth-trowel finish, offers strong, hard surfaces when densified by extensive troweling through set. May be retempered; permits mixing large batches for job-colored finishes. Requires high-strength gypsum basecoat. Two types: *Regular* (3–6 hr. set); *Quick Trowel* (1–2 hr. set.) Meets ASTM C61 and Federal Specification SS-C-161A Type I (Regular), Type II (Quick Trowel). Available in 100-lb. bags.

Finish Limes

The purpose of finish lime is to provide bulk, plasticity and ease of spread for the finish coat.

There are two types of finish lime: (1) *double hydrate (Type S),* (2) *normal or single hydrate (Type N).* Each requires different preparation in order to produce a good finish-lime putty.

IVORY and SNOWDRIFT Finish Limes—Autoclaved (double-hydrate)—immediately develop high plasticity when mixed with water and do not require overnight soaking. Virtually eliminate the possibility of future expansion within the finish coat because of unhydrated magnesium oxides. IVORY and SNOWDRIFT Limes are easy to apply and have excellent spreading qualities. Both comply with ASTM C206, Type S, and Federal Specification SS-L-351B, Type F. Available in 50-lb. bags.

RED TOP and GRAND PRIZE Finish Limes—Hydrate—economical, easy working, uniform, white and plastic. Require

soaking at least 16 hrs. to develop proper plasticity and the degree of hydration necessary prior to use. Both products comply with ASTM C6, Type N, and Federal Specification SS-L-351B, Type F. Available in 50-lb. bags.

Gauged-Lime Finishes—Coverage(1)

product	ratio of mix (dry wt.)			approx. coverage(2)	
	lime	gauging	sand(3)	yd^2/ton	m^2/t(4)
CHAMPION, STAR and RED TOP Gauging	2	1	—	390	360
	2	1	8	280	260
STRUCTO-GAUGE Gauging	1	1	—	380	350
	2	1	—	430	400
RED TOP Keenes Cement	2	1	8	270	250
	1	2	—	370	340
	1	2	8	270	250

(1)Over conventional basecoat plasters; over veneer basecoats, coverage is increased. (2)Natural, uniformly graded, clean silica sand. (3)1/16" (1.6mm) thickness. (4)Metric ton.

Finish Coat Plasters

ORIENTAL Exterior Finish Stucco is a white, water-resistant finish for exterior portland cement-lime basecoats. Mill-prepared; requires water only. Easily hand or spray-applied as float, splatter-dash and other texture finishes; not designed for smooth-trowel finish. One ton covers 150–200 sq. yd. in 1/8" thickness. Available in 9 additional colors Southwest only. In 100-lb. bags.

RED TOP Finish—Mill-mixed gauged interior finish requiring addition of water only. Has stabilized set, excellent troweling characteristics. Two formulations available: *Regular Set,* for use over conventional sanded gypsum basecoat, and *Quick Set,* for use over IMPERIAL Basecoat. Not for use over lightweight aggregate gypsum basecoat. Available in 50-lb. bags.

Special Plasters and Additives

USG Moulding Plaster—Used for specialized work such as ornamental trim or running cornices. The plaster grain is very fine, ideal for sharp detail when used neat for cast work. Controlled set provides uniform workability. For running cornice work, add a small amount of lime putty to add plasticity and to act as a lubricant for the template. Provides approx. 1.5 cu. ft. per 100 lbs. Complies with ASTM C28 and Federal Specification SS-P-00402B, Type V. Available in 50- and 100-lb. bags.

HYDROCAL White Gypsum Cement—Has exceptional strength and is recommended for ornamental work having thin sections and for castings made with intricate latex moulds where its high green strength minimizes breakage. In 50- and 100-lb. bags.

RED TOP Retarder and RED TOP Accelerator—Available for use with plaster when required by job or climate conditions. When used in excess, setting and drying problems can arise. Avoid especially, use of too much retarder, which can weaken the plaster finish. Available in 1½-lb. (Retarder) and 2-lb. (Accelerator) packages.

Special Plasters—Approx. Yield

product	bag size		approx. volume (dry)	
	lb	kg	ft^3/100 lb	m^3/t(1)
USG Moulding Plaster	50 & 100	22.7 & 45.4	1.5	0.94
HYDROCAL White Cement	50 & 100	22.7 & 45.4	1.3	0.81

(1)Metric ton

Masons and Stucco Lime

BONDCRETE Air-Entraining Masons and Stucco Lime is a fine-grind, white, high-purity dolomitic lime, pressure-hydrated for immediate use in portland cement-lime plaster for interior and exterior use. Recommended for use in scratch, brown and finish coats. It produces a stucco that is free-flowing for spray application or easily spread with light trowel pressure. Excellent water retention allows the cement-lime plaster to resist suction and allow sufficient time for finishing. Not recommended for use with gypsum gauging plaster in gauged lime-putty finish. BONDCRETE Lime meets ASTM C207 and Federal Specification SS-L-351B, Type M. Available in 50-lb. bags.

chapter 5

conventional plaster construction

construction standards—

general product application

general planning procedures

Two ingredients are required for a *quality plaster job*—quality products and skilled craftsmen correctly employing good lathing and plastering practices. U.S.G. plaster bases, plasters and plastering accessories are top-quality products designed to *work together,* job-proven and regularly improved. But without proper planning and correct installation by the contractor, the products cannot be expected to produce the desired results.

This section deals with the basic recommendations and installation procedures that should be followed in planning and completing the best possible job. Good lathing and plastering practices can give the contractor greater profit through fewer callbacks, less waste and lower job costs, and quality results that produce quicker sales, higher prestige and an enduring business reputation.

Installation procedures are described for correct installation of wood and steel framing, together with frame-spacing and

fastener-selector charts. Also included are applications of plaster bases and accessories plus specific instructions for various types of framing and plaster base application for fire- and sound-rated assemblies.

Planning the Job

Advance planning by the plastering contractor can mean savings in time and materials cost and a better-appearing job.

Two areas of planning deserve special attention. In high-rise work it is essential to determine availability and charges for use of hoisting equipment on the job well in advance of the time when it will be needed. Failure to do so can result in costly delays while the hoist is tied up by other trades.

In all types of jobs it is wise to plan for clean-up as the work proceeds, not when the job is finished. Contractors who have adopted the practice affirm that it reduces job costs. They've discovered that it's easier, faster and cheaper to remove drop-cloths of roofing paper than to scrape up set plaster. And stuffing electrical boxes with paper before plastering begins is far less costly than digging out set plaster when they are accidentally filled. When machines are shut down, they should be hosed off and thoroughly cleaned—made ready for a fresh start. The benefits from these good working practices add up to faster completions, less down time and equipment maintenance, and more profit.

Estimating Materials

Accurate take-off and estimating quantities of materials are an essential part of job planning. Underestimating causes expensive job delays while quantities are refigured and orders placed. Overestimating invariably results in damage or loss of at least part of the surplus materials.

The tables in Chapter 4 contain data needed for accurate estimating: packaging, coverage of various cementitious materials, and number of accessories needed per 100 sq. yd. of finished surface. Similar data on USG Steel Studs, Runners and Screws can be found in Chapter 1.

general job conditions

Handling and Storage

All successful plaster jobs require adequate equipment: power mixers, mortar boards, scaffolding and tools. Ample scaffolding should be provided to permit continuous application of both basecoat and finish plasters for a complete section of wall or ceiling. Obtain clean water for washing all mixing tools.

Lath and plaster products should be ordered for delivery to the job just prior to application. Materials stored on the job for longer periods are liable to damage and abuse.

Rather than ship all plaster to the job at one time, fresh plaster should be delivered as needed. Plaster stored for long periods is subject to variable moisture conditions and aging that can produce variations in setting time and performance problems.

Store plastering products inside, in a dry location and away from heavy-traffic areas. Stack plaster bags on planks or platforms away from damp floors and walls. Store gypsum plaster bases flat on a clean dry floor; vertical storage may damage edges or deform board. Protect metal corner beads, casing beads and trim from being bent or damaged. All materials used on the job should remain in their wrappings or containers until used.

Warehouse stocks of plaster products should be rotated to assure a supply of fresh materials and to prevent damage to plaster through aging and contact with moisture.

Environmental Conditions

When outdoor temperatures are less than 55°F. (13°C), the temperature of the building must be maintained in the uniform range of 55° to 70°F. (13° to 21°C) both day and night for an adequate period prior to the erection of gypsum plaster base, the application of plaster, while the plastering is being done, and until the plaster is dry. The heat should be well distributed in all areas, with deflection or protective screens used to prevent concentrated or irregular heat on plaster areas near the source.

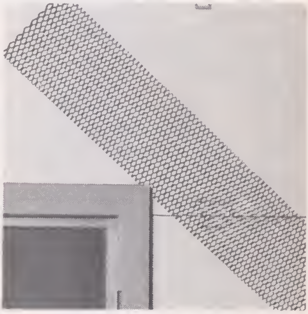
Ventilation must be provided to properly dry the plaster during and subsequent to its application. In glazed buildings, this should be accomplished by keeping windows open sufficiently to provide air circulation; in areas lacking normal ventilation, moisture-laden air must be mechanically removed.

framing installation

Reinforcing

Openings in a gypsum lath-and-plaster membrane, such as door frames, borrowed lights, etc., cause a concentration of stresses in the plaster, typically at intersection of head and jamb. The use of additional reinforcement (channels, runners, Striplath, self-

Reinforcing of frame



Reinforcing at door

furring diamond mesh lath) is recommended at the weakened area to distribute concentrated stresses.

Wood or metal inserts used as reinforcing or for attachment of cabinets and shelving on non-resilient surfaces should always be applied behind the plaster base to prevent breaking up the stress skin of the plaster. Heavy fixtures such as water closets and lavatories should be supported by separate carriers and not by the lath and plaster surface.

Wood and Steel Framing

Requirements for framing with wood and USG Steel Studs are the same for plaster and drywall construction and are covered in Chapter 2 of this manual. Maximum frame spacing for plaster base, which is not shown in Chapter 2, follows:

Frame Spacing—Gypsum Base (Ceilings & Sidewalls)

	base thickness		max. frame spacing o.c.	
type framing	in	mm	in	mm
Wood	3/8 1/2	9.5 12.7	16 24	406 610
USG Steel Stud	3/8 3/8 1/2	9.5 9.5 12.7	16 24(1) 24	406 610 610
TRUSSTEEL Stud	3/8	9.5	16	406
3/4″ (19.1 mm) Channel	3/8	9.5	16	406
USG Metal Furring	3/8 1/2	9.5 12.7	16 24	406 610

(1)Three-coat plastering.

TRUSSTEEL Stud Framing

TRUSSTEEL Stud Framing is installed by aligning TRUSSTEEL Snap-In or TRUSSTEEL Runner Track and anchoring to concrete slab using concrete stub nails or power-driven anchors spaced not over 24″ apart.

For anchoring to ceiling grillage, tie runners with a double strand of 18-ga. tie wire spaced not more than 16″ o.c.; to plaster or gypsum lath use toggle bolts or staples spaced not more than 24″ o.c. For best sound control, caulk perimeter of ROCKLATH Base and plaster at floor line. Install THERMAFIBER Sound Attenuation Blankets within the stud cavity where indicated for desired rating.

In all fire-rated partitions, TRUSSTEEL Studs must be attached to the TRUSSTEEL or Snap-In Runner Track with TRUSSTEEL Stud Shoes at the ceiling. Snap-in runner track with studs cut accurately to lengths may be used for floor and ceiling attachment where the construction is non-fire-rated. This track may be used at the floor in fire-rated partitions.

With TRUSSTEEL Runner Track and Stud Shoes, the stud length must be within 3″ of ceiling height; with Snap-In Runner Track, within ⅜″ of ceiling height. Place studs vertically, 16″ o.c., and snap into runner tracks at floor; at ceiling, secure with pair of shoes crimped or tied in place with double strand of 18-ga. tie wire. Locate a stud 2″ from abutting partitions, partition corners, partition terminals and door or borrowed light openings.

TRUSSTEEL Stud Shoes are wire-tied at ceiling runner

. . . same studs positioned in snap-in floor runner.

physical data

TRUSSTEEL Stud-Gypsum Lath Partitions

stud size		finished thickness				max. partn. height	
		direct attach.		resil. attach. one side		studs 16″ (406mm) o.c. (2) (3)	
in	mm	in	mm	in	mm	ft	m
1⅝	41	3⅝	92	(1)	(1)	9	2.7
2½	64	4½	114	4¾	121	15	4.6
3¼	83	5¼	133	5½	140	21	6.4
4	102	6	152	6¼	159	22	6.7
6	152	8	203	8¼	210	26	7.9

(1) Not recommended for resilient attachment. (2) Resilient partition limiting height is 10 ft. (3m). (3) Limiting heights based on L/360 deflection.

TRUSSTEEL Stud-Metal Lath Partitions

stud size		finished thickness		max. partition height (1)	
		diamond mesh or 1/8″ (3.2mm) lath		studs 16″ (406mm) o.c.	
in	mm	in	mm	ft	m
1⅝	41	3⅛	79	9	2.7
2½	64	4	102	15	4.6
3¼	83	4¾	121	21	6.4
4	102	5½	140	22	6.7
6	152	7½	191	26	7.9

(1) Limiting heights based on L/360 deflection.

Wall Furring

Exterior wall furring is a method of spacing the plaster base and plaster away from masonry walls to provide an air space, a chase for services and to accommodate insulation. By furring, uneven walls can be brought out to true, even surfaces. Plaster base can be quickly attached, and the uniform plaster base saves plastering material and labor.

Exterior masonry walls should be furred out and a vapor retarder provided. Several systems are available; each provides structural and cost advantages for special furring conditions.

A properly designed wall furring system should provide:

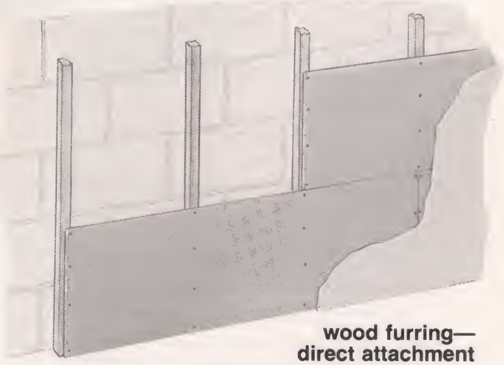
1. Condensation control.
2. Protection from moisture seepage.
3. Insulation and vapor retarder.
4. Some isolation from structural movement. Exterior walls are subject constantly to changing dimensions due to temperature changes and wind loads.

wood-ROCKLATH Base furring

For masonry wall furring, ROCKLATH Plaster Base and gypsum plaster over wood furring strips is an economical assembly. The

wood furring is usually 1×2 or 2×2 strips spaced 16″ o.c. for ⅜″ lath, 24″ o.c. max. for ½″ lath. Apply furring vertically and securely attach to the masonry. If necessary, use small wooden wedges to shim strips to a level surface.

Installation—Apply 16″×48″ ROCKLATH Plaster Base at right angles to furring strips with end joints occurring at strips. For ⅜″ ROCKLATH use 1⅛″ nails, for ½″ thickness use 1¼″ nails. When ROCKLATH Base has been installed, reinforce inside corners with Cornerite.



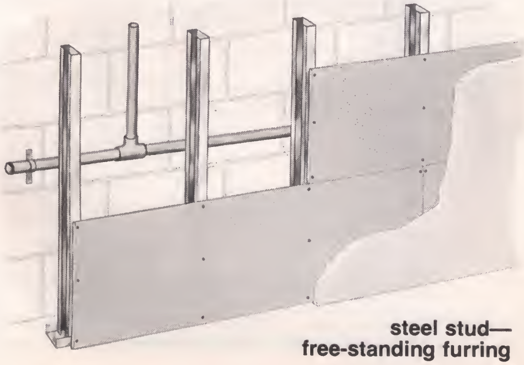
wood furring—
direct attachment

steel stud-ROCKLATH Base furring

This free-standing furring assembly consists of ROCKLATH Plaster Base screw-attached to USG Steel Studs and finished with gypsum plaster. The assembly offers a maximum of free space for encasement of pipes, ducts or conduits.

With Foil-Back ROCKLATH Base, the assembly provides an effective vapor retarder.

Installation—Align floor and ceiling runners parallel to wall and positioned to provide required chase space. Attach to concrete slabs with concrete stub nails or power-driven anchors 24″ o.c., to suspended ceilings with toggle or molly bolts 16″ o.c., or to wood framing with 1″ USG Type S Screws 16″ o.c.



steel stud—
free-standing furring

Position steel studs vertically in runners, 16″ o.c. for ⅜″ lath, 24″ o.c. for ½″ lath, and with all flanges in same direction. Anchor all studs that are adjacent to doors and window frames, partition intersections and corners to floor and ceiling runner flanges with screws. Attach ROCKLATH Base to studs with three 1″ Type S Screws at each stud. Apply ½″ sanded basecoat plaster, lime putty finish.

USG Steel Stud-ROCKLATH Furring—Max. Height

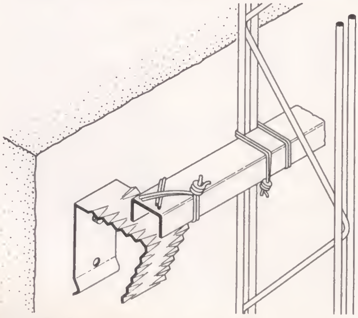
steel stud			spacing cc		max. height(2)	
style	width in	width mm	16″ (406mm)	24″(1) (610mm)	ft-in	mm
158ST	1⅝	41	X		8′3″	2515
				X	7′3″	2210
212ST	2½	64	X		10′9″	3275
				X	9′6″	2895
358ST	3⅝	92	X		13′9″	4190
				X	12′0″	3660
400ST	4	102	X		14′9″	4495
				X	13′0″	3960
600ST	6	152	X		19′9″	6020
				X	17′3″	5260

(1) 24″ spacing limited to ⅜″ ROCKLATH Base and 3-coat sanded plaster to ½″ grounds or ½″ ROCKLATH and sanded plaster. (2) Based on L/360 deflection or bending stress and no intermediate support.

TRUSSTEEL stud-ROCKLATH Base furring

In this system, TRUSSTEEL Studs provide a furred framing that is braced with ¾″ channels to support ROCKLATH Plaster Base.

Installation—Attach USG Adjustable Furring Brackets at 32″ o.c. horizontally and at ⅓-points vertically. Also, place brackets not over 4″ from columns or other abutting construction and above and below window or door openings as required. Drive 2″ cut nails or TAPCON Anchors through top hole of bracket into mortar joints of brick, clay tile, concrete block or in the field of lightweight aggregate blocks. For monolithic concrete use ⅝″ concrete stub nails, TAPCON Anchors or power-driven fasteners.



braced furring wall attachment

Align TRUSSTEEL or Snap-In Runner Tracks on floor and ceiling at 2″ max. distance from wall. Install TRUSSTEEL Studs 16″ o.c. and brace with ¾″ channels wire-tied to inside of stud chords at ⅓-points of free-standing wall height. Fasten channel braces to brackets with double strand of 18-ga. tie wire. Attach lath direct to studs. See TRUSSTEEL Stud-ROCKLATH Base Partition section for application and accessories.

Plaster Application—Apply a sanded basecoat plaster with finish plaster to ½″ grounds. See mixing and application directions in this chapter.

TRUSSTEEL Stud Furring—Max. Height

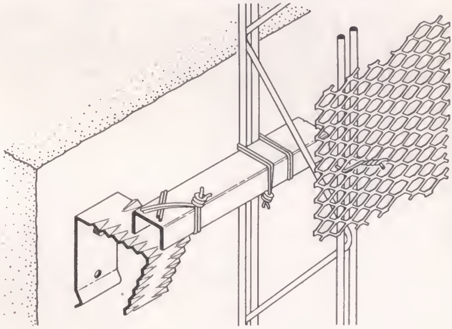
stud size		max. allowable height (1)			
		braced furring		free-standing furring	
in	mm	ft	mm	ft	mm
1⅝	41	9	2745	6	1830
2½	64	15	4575	10	3050
3¼	83	21	6400	14	4270
4	102	22	6705	15	4575
6	152	26	7925	17	5180

(1)Based on 16″ (406mm) o.c. framing spacing.

TRUSSTEEL stud-metal lath furring

Install TRUSSTEEL wall furring, braced as described in preceding gypsum lath section, or free-standing with studs spaced 16″ o.c. for 3.4-lb. diamond mesh metal lath or paper-backed lath. Attach metal lath with wire ties to studs with 18-ga. tie wire. Plaster to ⅝″ grounds over face of lath.

braced furring with metal lath



Frame Spacing and Attachment

For Furred Ceilings—Fasten ¾″ USG Cold-rolled Channel or ⅜″ pencil rods directly to bottoms of framing members. On concrete

joists, 10-ga. galvanized wire can be put in place before the concrete is poured. Space furring members as shown in cross-furring member spacing table. For joists spaced about 25″ o.c., attachment of ¾″ channels may be on alternate joists; if greater than 25″ o.c. but not more than 48″ o.c., place attachment at every joist.

On steel joists or beams, place ¾″ cold-rolled channels at right angles to joists; attach with 3 strands 18-ga. galvanized wire.

For Suspended Ceilings—Space 8-ga. wire hangers not over 4′ o.c. in direction of 1½″ carrying channels and not over 3′ o.c. at right angles to direction of carrying channels, and within 6″ of ends of carrying channel runs and of boundary walls, girders or similar interruptions of ceiling continuity. Position and level carrying channel and saddle-tie securely with hanger wire.

Position ¾″ USG Cold-rolled Channel (cross-furring) across carrying channels, spacing them 12″ to 24″ depending on type of metal lath to be used, and saddle-tie carrying channels with three strands of 18-ga. tie wire.

Apply USG 3.4-lb. Diamond Mesh Lath, ⅛″ Z-Riblath or ⅜″ Riblath as specified with long dimension of sheets across the supports. For details on lathing procedures and control joints, see Chapter 7.

Frame and Fastener Spacing—ROCKLATH Plaster Base

type framing	base thickness		fastener(1)	max. frame spacing		max. fastener spacing	
	in	mm		in	mm	in	mm
Wood	⅜	9.5	Nails—13 ga., 1⅛″ long, 19⁄64″ flat head, blued	16	406	5	127
			Staples—16-ga. galv. flattened wire, flat crown 7⁄16″ wide, 1″ divergent legs				
	½	12.7	Nails—13 ga., 1¼″ long, 19⁄64″ flat head, blued	24	610	4	102
			Staples—16-ga. galv. flattened wire, flat crown 7⁄16″ wide, 1″ divergent legs				
USG Steel Stud (ST)	⅜	9.5	1″ Type S Screws	16	406	12	305
	½	12.7		24	610	6	152
TRUSSTEEL Stud	⅜	9.5	TL-1 or TR-1 Clips	16	406	16	406
¾″ (19.1mm) Channel	⅜	9.5	BRACE-TITE Clips	16	406	16	406
USG Metal Furring	⅜	9.5	1″ Type S Screws	16	406	12	305
	½	12.7		24	610	6	152

(1)Metric fastener dimensions: 19⁄64″=7.5mm; ⅜″=9.5mm; 7⁄16″=11.1mm; 1″=25.4mm; 1⅛″=28.6mm; 1¼″=31.8mm.

Max. Frame Spacing—Metal Lath(1)

product	weight		spacing	
	lbs/yd²	kg/m²	in	mm
Diamond Mesh(2)	2.5 3.4	1.4 1.8	12(3) 16	305(3) 406
⅜″ (9.5mm) Riblath	3.4	1.8	24	610
4-Mesh Z-Riblath	2.75 3.4	1.5 1.8	16(4) 19(5)	406(4) 483
Stuccomesh	3.6	2.0	16	406

(1)For spacing on fire-rated constructions, see test reports.
(2)2.5-lb. lath should not be used for ceilings. (3)16″ o.c. permitted with wood framing and 2″ solid partition. (4)Spacing of metal ceiling grillage 12″ o.c. (5) 24″ spacing with solid partition.

Support Area—Hangers

hanger size and type	max. ceiling area per hanger	
	ft²	m²
9-ga. galvanized wire	12.5	1.2
8-ga. galvanized wire	16	1.5
3/16″ (4.8 mm) mild steel rod (1)(2)	20	1.9
¼″ (6.4 mm) mild steel rod (1)(2)	22.5	2.1
3/16″×1″ (4.8mm×25.4mm) mild steel flat (1)(2)	25	2.3

(1)Where severe moisture conditions may occur, rods galvanized or painted with rust-inhibitive paint, or galvanized straps are recommended. (2)Not manufactured by United States Gypsum.

Max. Spacing—Main Runner—Carrying Channels

main runner c. r. channel size		max. c. to c. spacing of main runners		max. spacing of hangers along runners	
in	mm	ft	mm	ft	mm
¾	19.1	3	914	2	610
¾	19.1	2¼	686	3(1)	914
1½	38.1	4	1219	3	914
1½	38.1	3½	1067	3½	1067
1½	38.1	3	914	4	1219
2	50.8	4	1219	5	1524
2	50.8	2½	762	6	1829
2	50.8	2	610	7	2134

(1)For concrete joist construction only—where 8-ga. wire may be inserted in joist before concrete is poured.

Max. Spacing—Cross-Furring Members

cross-furring size	max. c. to c. spacing of cross-furring		main runner or support spacing	
	in	mm	ft	mm
¾″ (19.1 mm) C. R. Channel	24	610	3	914
¾″ (19.1 mm) C. R. Channel	19	483	3½	1067
¾″ (19.1 mm) C. R. Channel	16	406	4	1219
1″ (25.4 mm) H. R. Channel	24	610	4	1219
1″ (25.4 mm) H. R. Channel	19	483	4½	1372
1″ (25.4 mm) H. R. Channel	12	305	5	1524
⅜″ (9.5 mm) Pencil Rod(1)	19	483	2	610
⅜″ (9.5 mm) Pencil Rod(1)	12	305	2½	762

(1)Primary usage is on furred ceiling members.

plaster base application

Plaster bases may be classified as (1) *gypsum* or *metal lath* bases, or (2) *masonry* bases. These materials provide a level surface for plastering and add reinforcement to the plaster. As such, they must be rigid enough to accept plaster and produce a secure bond between plaster and base—both necessary to develop strength and resistance to abuse and cracking.

To insure adequate rigidity of plaster constructions, recommendations for the spacing of supports and fasteners must be strictly followed.

Apply plaster bases to ceilings first and then to partitions, starting at the top and working down to the floor line. *Exception:* In application of ROCKLATH Base to TRUSSTEEL Studs, begin application at floor.

ROCKLATH Plaster Base—An ideal high-suction rigid base for gypsum plasters, should be applied face out with long dimension across supports and with end joints staggered between courses. Cut lath accurately so it slips easily into place without forcing and fits neatly around electrical outlets, openings, etc. Except where BRIDJOINT Clips are used, lath ends should bear on supports and be securely fastened. Install any lengthwise raw cut edges at bottom strip or wall-ceiling angle. BRIDJOINT B-1 Clips should be used at end joints between supports. Apply Cornerite to all interior angles. Staple to the lath only.

USG Metal Lath—Should be applied with long dimension across supports and with end joints staggered between courses. Apply Riblath with the rib against supports. Lap ends of metal lath 1″ and sides at least ½″. Lap Riblath by nesting outside ribs. If end laps occur between supports, they should be laced or tied with 18-ga. tie wire. Secure lath to all supports at intervals not exceeding 6″. At all interior angles, metal lath should be formed into corners and carried out onto abutting surface.

Clay Tile and Brick—Frequently used for plaster bases. Care should be taken to make sure that surfaces are sufficiently porous to provide suction for the plaster and are scored for added mechanical bonding. Smooth-surfaced clay tile that is glazed or semi-glazed does not offer sufficient bond for plaster.

Concrete Block—A satisfactory base for plaster. The surface should be porous, for proper suction, or face-scored for adequate mechanical bond. Units must be properly cured to minimize dimensional changes during and subsequent to plastering.

Monolithic Concrete—Ceilings, walls, beams and columns should have a complete and uniform application of a high-quality bonding agent before plastering. This surface treatment produces an adhesive bond suitable for direct application of gypsum plasters.

Plastering Direct to Exterior Masonry Walls—Not recommended. Exterior walls are subject to water seepage and moisture condensation that may wet the plaster and damage interior decoration.

Bituminous Waterproofing Compounds—Do not provide a good

plaster base. Gypsum plasters should not be applied to surfaces treated with these compounds.

Rigid Foam Insulations—Have not proven to be satisfactory plaster bases for direct application of gypsum plaster because of rigid foam insulation's low suction characteristics and low structural strength which may result in cracking of the plaster.

U.S.G. does not recommend direct application of plaster to rigid foam insulation. However, some rigid foam insulation manufacturers have specific directions for application when direct plastering is to be used, as well as detailed specifications for plaster mixes and methods of application to be employed.

United States Gypsum has designed various furring systems (covered earlier in this chapter) that avoid the need to apply plaster to these unsuitable surfaces and do provide high-quality plaster finishes over the inside of exterior walls.

fastener application

Correct fastener selection and adherence to spacing, extremely important to good performance, are absolutely essential in meeting requirements of specific fire-rated constructions.

Gypsum Plaster Bases—Attached to framing with screws, nails, staples or special clips. Nails, screws and staples should be driven so that the fastener head or crown bears tightly against the base but does not cut the face paper. To prevent core fracturing, they should be driven at least ⅜″ away from ends and edges. Staples should be of flattened wire driven so the crown is parallel to wood framing. Screws should be used to attach gypsum plaster bases to USG Steel Studs, Furring Channels or RC-1 Resilient Channels. ROCKLATH Plaster Base may also be applied to USG Steel Studs with MS-1 Clips.

For screw attachment of single-layer ⅜″ ROCKLATH Base to USG Steel Studs or Furring Channel, USG 1″ Type S Bugle Head Screws are used. Attach metal door frames to steel studs, using ⅜″ USG Type S-12 Pan Head Screws; for steel studs to metal runners up to 20 ga., ⅜″ USG Type S Pan Head Screws. For steel to steel attachment from 20- to 14-ga., use ⅝″ Type S-12 Low-Profile Head. For attaching base to 20- to 14-ga. studs, use Type S-12 screws. See Chapter 2 for complete data on USG Screws and the electric screwguns designed for their use.

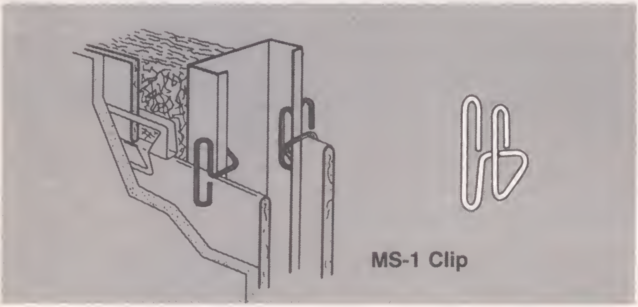
Nail Application—Begin from center of base and proceed toward outer ends or edges. When nailing, apply pressure adjacent to nail being driven to insure base is secured tightly on framing member. Position nails on adjacent ends or edges opposite each other and at least ⅜″ from ends and edges. Drive nails with shank perpendicular to plaster base. The nailheads should be driven flush with paper surface but not break paper.

Metal Lath—Attach to TRUSSTEEL Studs or cold-rolled channel framing with tie wire (min. 18 ga.) and to wood framing with fasteners engaging two strands or a rib and providing at least ¾″ penetration.

gypsum lath-USG steel studs

For Clip Attachment—Fasten ROCKLATH Base with USG MS-1 Clips to studs spaced 16″ o.c. and secure corners of lath with BRIDJOINT B-1 Clips. The TRUS-LOK Drive-in Clip may be used as a starter-finisher clip.

For non-load bearing applications, do not use CS-style studs (no lip). If lateral bracing is required, use steel V-bracing or cold-rolled channels properly installed.

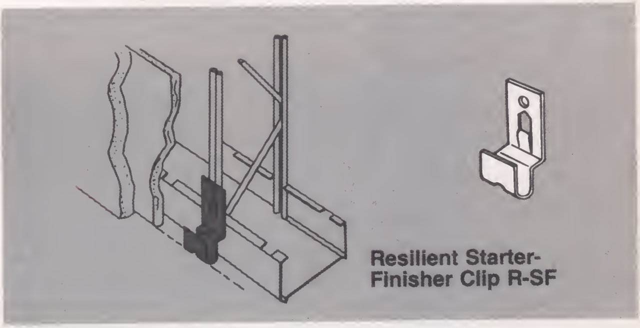


For Screw Attachment—For 16″×48″ ROCKLATH Base, fasten ⅜″ thickness to studs spaced 16″ o.c. with two 1″ Type S Screws per stud spaced 2″ from edge of lath; for ½″ thickness fasten to studs 24″ o.c. with 1″ Type S Screws, three screws per stud. Type S-12 Screws required for heavier gauges. Fasten ½″×24″×96″ long-length lath the same as regular ½″ lath. Drive screws with an electric screwgun. Secure corners of ⅜″ lath falling between studs with BRIDJOINT B-1 Clips.

Screw attachment of ROCKLATH Base to steel studs

gypsum lath-TRUSSTEEL studs

For Resilient Attachment (recommended one side only)—Start at bottom with long dimension of ⅜″ ROCKLATH Plaster Base at right angle to studs. Butt ends of ROCKLATH Base together and clip in place using Resilient Starter-Finisher Clip R-SF and Resilient Field Clip TR-1, spaced max. 16″ o.c. Stagger end joints between studs and align corners of lath with BRIDJOINT B-1 Field Clips.



For Direct Attachment—Follow procedure for resilient attachment but use TRUS-LOK Starter Clips TL-2 for first course and TRUS-LOK Field Clips TL-1, spaced max. 16″ o.c., for succeeding courses. Stagger ends of lath between studs and secure with BRIDJOINT B-1 Field Clips. Fasten finishing course of ROCKLATH Base with 1″ No. 12 flat head self-tapping sheet metal screws, driven between vertical stud wires and spaced 8″ from ceiling. Anchor bottom course of lath with TRUS-LOK Drive-in Clips.

Intermediate course of lath slips into TRUS-LOK Field Clips (left) and into BRIDJOINT Field Clip at end joints (right).

TRUS-LOK Drive-in Clip tapped into place to secure bottom course of ROCKLATH Base in TRUSSTEEL Stud partition.

metal lath-TRUSSTEEL studs

Tie Diamond Mesh Lath to stud chord with 18-ga. tie wire at 6″ intervals along each stud flange.

Apply Riblath with rib projections against supports, and wire-tie to supports 6″ o.c. Nest side and end ribs of lath and wire-tie between supports at max. 9″ intervals. Stagger ends on all types of lath sheets so that lath on opposite sides and sheets below on same side do not end on same stud. Lace end laps or wire-tie at 9″ intervals.

gypsum lath-wood framing (direct)

Nail ROCKLATH Plaster Base with face out and long dimension across framing members. Stagger end joints in successive courses with ends of lath falling on framing members. Butt all joints together and cut lath to fit neatly around electrical outlets and other openings.

For ⅜" ROCKLATH Plaster Base with 16" o.c. stud spacing, use four fasteners, 5" o.c. per 16" width of lath. For ½" ROCKLATH Plaster Base and max. support spacing of 24" o.c., use five fasteners, 4" o.c. per 16" width of lath. Place fasteners at least ⅜" from edges and ends of lath. Make all interior plaster angles the floating type and space first fasteners at least 10" from corner.

Power nailer used to attach ROCKLATH Plaster Base to ceiling

metal lath-wood framing (direct)

Apply metal lath with long dimension of sheet across supports. Lap ends of lath at least 1" and if laps occur between supports, lace or tie with 18-ga. tie wire. Attach with fasteners 6" o.c. so fastener engages two strands or a rib and provides at least ¾" penetration.

On walls, place metal lath so that the lower sheets overlap upper sheets and, where possible, stagger ends of lath in adjacent courses.

At all interior angles, form lath into corners and carry out onto abutting surface. Secure lath to joists with 1½" galvanized nails, to studs with nails or staples providing min. ¾" penetration.

isolation and control joints

USG Control Joint

Lath and plaster surfaces (non-load bearing) will not resist stresses imposed by structural movement and are subject to dimensional changes caused by changes in temperature and humidity. (See Appendix for Thermal and Hygrometric Coefficients of Expansion.) Such surfaces should be isolated from the following structural elements by control joints, casing beads or other means where:

a. A partition or ceiling abuts any structural element except the floor, dissimilar wall or partition assembly, or other vertical penetration.

b. The construction changes within the plane of the partition or ceiling and wings of "L-", "U-" and "T-" shaped ceilings are joined.

In long partition runs, control joints should be provided at max. 30 ft. o.c. Door frames extending from floor to ceiling may be used as control joints. For less-than-ceiling-height doors, control joints extending from center or both corners of frame to ceiling is an effective application. If control joints are not used, additional reinforcement is required at corners to distribute concentrated stresses. (Door frame details appear later in this chapter.) In exterior wall furring systems, control joints must be provided wherever control joints are located in the exterior wall, at max. 30 ft. o.c.

Large interior ceiling areas with perimeter relief should have control joints spaced at max. 50 ft. o.c. in either direction;

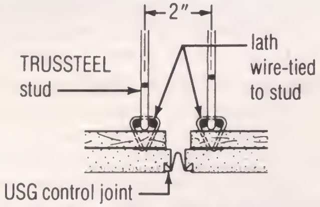
Max. Spacing—USG Control Joints for Interior Assemblies

system	location	max. single dimension		max. single area	
		ft	mm	ft²	m²
Metal Lath & Plaster	Partition	30	9144	—	—
	Ceiling	50(1)	15240	2500	230
		30(2)	9144	900	83.6
Gypsum Lath & Plaster	Partition	30	9144	—	—
	Ceiling	50(1)	15240	2500	230
		30	9144	900	83.6

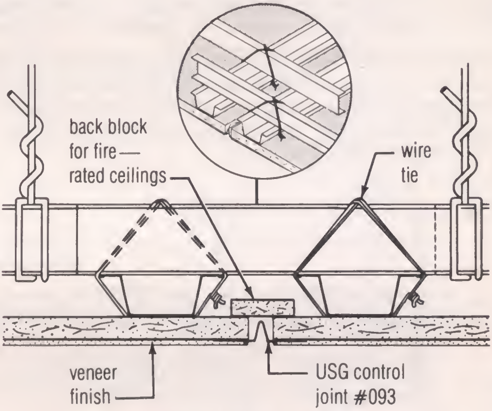
(1) with perimeter relief (2) without perimeter relief

without perimeter relief, 30 ft. o.c. maximum in either direction. The continuity of both lath and plaster must be broken at the control joints. Control joints should be positioned to intersect light fixtures, heating vents, or diffusers, etc., which already break ceiling continuity, and are points of stress concentration.

Installation—Provide a break in the lath at location of control joint. At this location install double framing members, one on each side of the break and 2″ apart. Place control joints over all control or relief joints within structural frame of building. Staple or wire-tie perforated flanges of control joint to lath. Plaster flush to grounds. Remove factory-applied protective tape after completion of finished surface.



wall control joint installation



ceiling control joint installation

application—basecoat plasters

For the beauty and durability of which plaster is capable, certain requirements should be followed as to the number of coats applied. Three-coat work is necessary on all metal lath and on edge-supported gypsum lath used in ceilings; three-coat work is desirable on all gypsum lath but two-coat work is acceptable when gypsum lath is properly supported and on masonry plaster bases (rough concrete block, clay tile, porous brick).

In preparing for plastering, consideration should be given to the selection of materials not only for compatibility but for the quality of the structure to be plastered. It is wise to upgrade plastering specifications when possible.

The architect's specifications and the plaster base used will determine the plastering method, either two-coat or three-coat.

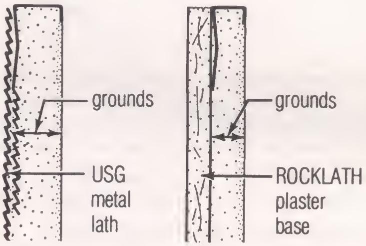
two- and three-coat plastering

Two-Coat Plastering with Conventional Plasters—Generally accepted for plaster application over gypsum lath and masonry—the base (first) coat should be applied with sufficient material and pressure to form a good bond to the base and to cover well; then be doubled back to bring plaster out to grounds, straightened to true surface with rod and darby without use of additional water, and left rough to receive finish (second) coat.

Three-Coat Plastering—Required over metal lath and edge-supported gypsum lath used in ceilings—is preferred for other bases because it develops a harder, stronger basecoat. The scratch (first) coat should be applied with sufficient material and pressure to form good full keys on metal lath, and a good bond on other bases, and then cross-raked. The brown (second) coat should be applied after scratch (first) coat has set firm and hard, brought out to grounds and straightened to true surface with rod and darby without use of additional water, and left rough to receive finish (third) coat.

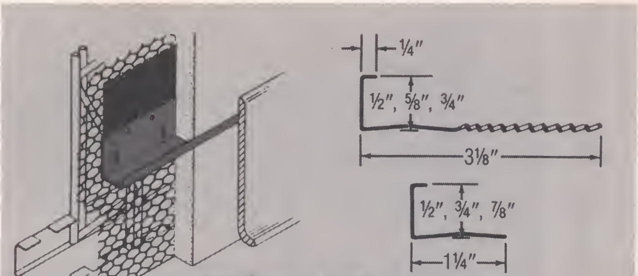
To obtain the full hardness, high strength and superior performance available in gypsum basecoat plasters, water, aggregates and setting time must be carefully controlled. In addition, proper mixing and drying of the plaster are required to obtain these superior functional characteristics.

grounds



The thickness of conventional basecoat plaster is one of the most important elements of a good plaster job. To insure proper thickness, grounds should be properly set and followed.
Grounds may be defined as wooden strips, corner beads (plumbed and aligned), or metal casing beads applied at perimeter of all openings and other locations.

In addition to these, and especially on walls with no openings and on ceilings, plaster screeds should be installed to insure plumb and level surfaces. Plaster screeds are either dots or continuous strips of plaster applied to required ground thickness to permit proper plumbing and leveling.



#66 Square Edge USG Casing Beads (expanded or short flange)

Grounds should be set to obtain the following minimum plaster thicknesses:

1. Over gypsum lath..................................½" (12.7mm)
2. Over brick, clay tile, or other masonry ....⅝" (15.9mm)
3. Over metal lath, measured from face of lath ...⅝" (15.9mm)

mixing

Use of the proper type of mechanical mixer assures that the plaster aggregate and water are evenly mixed. Keep the mixer continually clean—a *most* important precaution—because partially set material is a powerful accelerator.

Proportioning is *weight* of gypsum to *volume* of aggregate.

A No. 2 shovel used to add sand to the plaster mix generally carries 15 lb., or approx. one-sixth cubic foot. Thus, a 100:1 mix would use 6 shovels of sand to 100 lb. of gypsum plaster, a 100:2 mix 12 to 13, and a 100:3 mix 18 to 19 shovels of sand.

Perlite is generally packaged in bags containing 3 or 4 cu. ft. for easy proportioning.

Prepare only one hour's supply of plaster at one time and do not remix if plaster has started to set. All such plaster should be discarded.

Water—All gypsum plasters require addition of water on job. Water should be clean, fresh, suitable for domestic consumption, and free from mineral and organic substances which affect plaster set. Water used earlier for rinsing or cleaning containers and tools should not be used, as it accelerates plaster set.

Only enough water should be used to provide a plaster of workable consistency. Too much water in machine-applied plasters (in excess of 10% more than for hand-applied mixes) or over-aggregated plasters will cause weak, soft walls and ceilings. Excessive water reduces plaster strength and hardness.

Aggregates—Added to conventional gypsum plasters to extend coverage, reduce shrinkage, and lower cost. Aggregates recommended are: (1) *sand,* which is denser, stronger and provides greater sound transmission loss than lightweight aggregates, and (2) *perlite,* a lightweight aggregate that generally offers

better fire resistance, insulation values and reduced weight. For sand-float finishes the aggregate should be a fine silica sand.

All aggregates used should have proper gradation of size as outlined in ASTM C35. Improperly sized aggregates will produce weak walls. Sand should be clean and free of dirt, clay and foreign matter that might affect the setting time of plaster. Perlite-aggregated plasters should not be machine-applied when vertical lift is over 30 ft. or hose length exceeds 150 ft. Maximum recommended proportions for aggregates are shown in table below.

Max. Aggregate Quantity—Gypsum Plasters

base	no. coats(1)	coat	under smooth trowel finishes				under texture finishes			
			sand(2)		perlite(3)		sand(2)		perlite(3)	
			ft^3/100 lb	m^3/t	ft^3/100 lb	m^3/t	ft^3/100 lb	m^3/t	ft^3/100 lb	m^3/t
Gypsum Lath	3	Scratch	2	1.23	2	1.23	2	1.23	2	1.23
		Brown	3	1.84	2	1.23	3	1.84	3(4)	1.84(4)
	2	Basecoat(5)	2.5	1.54	2	1.23	2.5	1.54	2	1.23
Metal Lath	3	Scratch	2	1.23	—	—	2	1.23	2	1.23
		Brown	3	1.84	—	—	3	1.84	2	1.23
Unit Masonry	3	Scratch	3	1.84	3	1.84	3	1.84	3	1.84
		Brown	3	1.84	3	1.84	3	1.84	3	1.84
	2	Basecoat(5)	3	1.84	3	1.84	3	1.84	3	1.84

(1)Includes finish coat. (2)Approx. 6 No. 2 shovels of sand equal 1 cu. ft. (0.028m^3). (3)In a construction with metal lath as the plaster base, perlite aggregate is not recommended for use in the basecoat plaster, except under a float finish. For a smooth trowel finish over a perlite aggregated basecoat on any plaster base except metal lath, add ½ $ft.^3$ of fine silica sand per 100 lb. of gauging plaster, or use aggregated gauging. (4)3 $ft.^3$ only if applied 1″ thick, otherwise 2 $ft.^3$. (5)Basecoat applied scratch and double-back.

Setting Time—The proper setting time for conventional basecoat plasters is generally from 2 to 4 hours after mixing, and this should be checked for close conformity on both the scratch coat and brown coat operation. Normally, plaster shipped to the job will fall in this range. If conditions exist that affect normal setting time, retarders or accelerators may be used.

The danger of "quick set" plaster is insufficient time to get the plaster from mixer to walls without retempering on mortar board, and such retempering will produce a plaster of lower than normal strength. The correction for "quick set" is to add the minimum required amount of retarder in solution with water in the mixer.

If plaster does not set for 5 to 6 hr., no harm will be done to the resulting plaster surfaces, but a "slow set" of the plaster (generally one taking more than 6 hr.) should be avoided by adding accelerator at the mixer, as such plaster may be subject to a "dryout," particularly in hot, dry weather, and will have a lower than normal strength when finally set.

Only RED TOP Accelerator and RED TOP Retarder should be used. Other materials may not be compatible with U.S.G. plasters.

Heating and Ventilation—Plaster must not be applied to surfaces that contain frost. A min. temperature of 55°F. (13°C)

should be maintained for adequate period prior to, during, and after application of plaster. In cold, damp or rainy weather, properly regulated heat should be provided but precautions must be taken against rapid drying before set has occurred. This prevents "dryouts."

As soon as set occurs in conventional plasters, free circulation of air should be provided to carry off excess moisture. Heating should be continued to insure as rapid drying as possible. In hot, dry weather, protect plaster from wind and from drying unevenly or too rapidly before set has taken place. If fenestration or curtain walls are not in place, exterior openings in the building should be screened.

standard basecoat plasters

RED TOP Gypsum Plaster—This gypsum basecoat requires addition of aggregate and water. In three types: *Regular*—for use with sand aggregate, hand application; *LW*—for use with lightweight aggregate, hand application; *Machine Application*—for use with sand or lightweight aggregate.

RED TOP Wood Fiber Plaster—Can be applied to all standard lath and masonry surfaces and is recommended as a scratch coat for metal lath. One cu. ft. sand per 100 lb. plaster must be added for machine application and for application over masonry bases, and may be added for other applications.

RED TOP Two-Purpose Plaster—This gypsum basecoat plaster requires addition of aggregate and water on the job site. Used for either hand or machine application with sand or lightweight aggregate.

For scratch coat, add 2 cu. ft. of sand per 100 lb.; for brown coat, add up to 3 cu. ft. of sand per 100 lb. or as scratch for sand float finish, add 2 cu. ft. of perlite per 100 lb.

STRUCTO-LITE Gypsum Plaster—This mill-mixed perlite aggregated gypsum plaster requires addition of water only at the job site. Available in three formulations: *Regular*—for use over gypsum or metal lath; *Masonry*—for use over high-suction unit masonry; *Type S*—for specific UL-listed assemblies. (See Chapter 4 for physical data on basecoat plasters.)

STRUCTO-BASE Gypsum Plaster—A special gypsum basecoat that develops higher strengths than conventional plasters. Depending on strength desired, 2 to 3 cu. ft. of sand per 100 lb. is added on the job.

application—finish plasters

conventional plasters

Finish plasters applied to basecoats provide the surface for final wall or ceiling decoration. Finish coats should be applied only to properly prepared basecoats.

Trowel Finishes—Used where a smooth, easily maintained surface is desired, often as a base for paint or wallcoverings.

Trowel finish

Float finish

Spray finish

Texture finish

The degree of hardness, porosity, and polish is determined by the materials and application techniques used. When a smooth-trowel gauged lime putty finish is used over a basecoat containing lightweight aggregate on any plaster base except metal lath, three options are available. Either add at least 50 lb. of fine silica sand or ½ cu. ft. of perlite fines per 100 lb. of gauging plaster or use a U.S.G. mill-aggregated "Quality" gauging plaster.

Application—To avoid blistering, allow basecoat to dry sufficiently or use a quick-set gauging plaster. Use 50-lb. bag of IVORY or SNOWDRIFT Lime with 5½ to 6 gal. water. Machine-mix for immediate use. *For a medium-hard finish,* mix 100 lb. STRUCTO-GAUGE Gauging Plaster or 200 lb. CHAMPION, STAR or RED TOP Gauging Plaster to each 200 lb. dry lime (approx. 400 lb. putty). *For extremely hard finish,* mix one part STRUCTO-GAUGE Plaster to one part lime.

Scratch in thoroughly, then immediately double-back to a thickness of not more than 1⁄16" and trowel to a smooth, dense surface ready for decoration.

Float or Spray Texture Finishes—Provide attractive, durable finishes where surface textures are desired. They are recommended for use over all types of gypsum basecoats and are the most desirable finishes from the standpoint of crack resistance. The surface texture is easily controlled and can be produced by spray application, or a variety of hand tools.

Application, Sand Float Finish—Machine-mix finish in proportion of 100 lb. RED TOP Keenes Cement, 50 lb. dry hydrated lime, approx. 400 lb. sand and water to produce a mixture with smooth, plastic consistency.

Scratch in thoroughly over dry basecoat, then immediately double-back to a thickness of not more than ⅛". Hand float to produce a uniform texture free of blemishes. Use water sparingly during floating.

Application, Machine Spray Texture Finish—Basecoat must be free of ridges or other surface imperfections. Machine-mix finish in proportion of 100 lb. Keenes, 50 lb. dry hydrated lime, approx. 400 lb. sand and sufficient water to produce a mixture with smooth, plastic consistency. An equal volume of perlite aggregate may be substituted for sand where reduced surface hardness is acceptable.

Apply finish either with a hand-held hopper gun or other suitable

machine. Vary aggregate size, number of passes over surface, air pressure and nozzle orifice to achieve desired texture.

Other Texture Finishes—Many pleasing and distinctive textures are possible using various techniques in finishing. Finishes may range from an extremely fine stipple to a rough, heavy or coarse texture. Variety is limited only by the imagination of the designer or the ingenuity of the applicator.

limitations

Certain precautions must be observed when applying finish coat plasters over various basecoats:

1. A smooth-trowel finish should not be used over lightweight aggregate gypsum basecoat applied over metal lath. A sand-float finish is recommended.

2. Where the gypsum basecoat over any plaster base except metal lath is STRUCTO-LITE or contains lightweight aggregate and a smooth-trowel finish is used, the finish coat should be RED TOP Gauging Plaster and lime, with addition of ½ cu. ft. of perlite fines or 50 lb. of No. 1 white silica sand per 100 lb. gauging plaster or mill-aggregated "Quality" Gauging Plaster.

3. Gypsum or lime-base finishes, including Keenes Cement, should not be used directly over a portland cement basecoat or over concrete block or other masonry surfaces.

4. In smooth trowel finishes, gauging plasters providing an extremely hard surface, such as STRUCTO-GAUGE and Keenes Cement, must not be used over STRUCTO-LITE Plaster or a basecoat with a lightweight aggregate.

5. Lime putty cannot be used without the addition of gauging plasters. When used alone as a finish plaster, lime does not set, is subject to shrinkage when drying and lacks hard finish.

gauging plasters

CHAMPION, STAR and RED TOP Gauging Plasters—Gauging plaster (see following pages for full description) is blended into the lime putty in the proper proportions to provide controlled set, early hardness and strength, and to prevent shrinkage cracks.

Mixing—Add gauging plaster to lime putty in proportion of 1 part dry gauging plaster by weight to 2 parts dry lime by weight or 1 part dry gauging by volume to 3 parts lime putty by volume. To mix, form a ring of lime putty on mixing board. The volume of putty used depends on wall or ceiling area to be covered. A hod of lime putty weighs approx. 100 lb., a 12-qt. bucket of lime putty about 35 lb. (50 lb. dry lime equals 100 lb. lime putty). After forming the putty ring, pour clean water into center of ring in correct proportions: 6 qt. water to 100 lb. lime putty; 2 qt. water to each 12-qt. bucket of lime putty. Next, sift *Slow* or *Quick Set* gauging plaster into water; 25 lb. gauging plaster to one hod of lime putty. Thoroughly wet gauging plaster and blend materials *thoroughly* to prevent gauging "streaks" and provide uniform density.

Sift gauging plaster into water

Mix to blend thoroughly

To protect against finish coat check or map-cracking, add ½ cu. ft. perlite fines or 50 lb. fine silica sand to every 100 lb. of gauging used. This addition is necessary when applying smooth troweled finishes over lightweight aggregate basecoats. Mill-aggregated "Quality" gauging plasters are generally available and eliminate the need for on-the-job measuring.

Apply the gauged lime putty over a partially dry basecoat. Scratch in a thin coat, well ground into the basecoat, and double-back with a second coat, filling imperfections. After basecoat has absorbed most of excess water from finish, trowel to densify surface. As final set takes place, water-trowel surface to provide a dense, smooth surface.

STRUCTO-GAUGE Gauging Plaster—This high-strength gypsum finishing plaster is used with lime putty to produce an easily applied finish of extreme hardness.

Finish hardness may be altered by adjusting the proportions of lime putty and STRUCTO-GAUGE Plaster. Since the material cannot be retempered, use of regular Keenes Cement is recommended when retempering is a factor. STRUCTO-GAUGE Plaster is not recommended for use where excessive or continued moisture conditions exist. Application must be over high-strength sanded or wood-fibered gypsum basecoats.

Mixing—For a hard finish, mix proportions of 100 lb. dry hydrated lime (200 lb. of lime putty) to 100 lb. STRUCTO-GAUGE Plaster. For a medium hard finish, mix proportions of 200 lb. dry hydrated lime (400 lb. of lime putty) to 100 lb. STRUCTO-GAUGE Plaster. For best results, machine-mix.

Apply like regular finish over a partially dry gypsum basecoat. Scratch in thin coat, well ground into base, and immediately double-back with second coat, filling imperfections. Water-trowel to a smooth, hard finish, free of all blemishes. Continue troweling until final set has taken place. Clean tools and equipment after each mix.

RED TOP Keenes Cement—A high-strength white gypsum plaster used with finish lime putty for extremely hard, dense surfaces. It is the only gypsum plaster that can be retempered. Made in two types: *Regular* (3-6 hr. set) and *Quick Trowel* (1-2

hr. set). Quick-troweling Keenes *must* be used with a min. of 25 lb. dry hydrated lime per 100 lb. of Keenes.

Keenes Cement-Lime Finish is similar in many respects to a lime gauged finish except that Keenes Cement, instead of gauging plaster, is used in varying proportions depending on the hardness required and is generally used as a float finish. If a smooth-trowel hard finish is desirable, use STRUCTO-GAUGE Gauging Plaster. Keenes Cement is for interior use over sanded or wood-fibered gypsum basecoats. Do not apply smooth-trowel finish over lightweight aggregate basecoats.

Application, Sand Float Finish—Commonly used, hard float finish which may be satisfactorily colored. Mix in proportions of 100 lb. Keenes Cement to 50 lb. dry lime and 400 lb. sand, with or without limeproof colors. Apply in same manner as for Keenes Cement-Lime Finish but instead of final troweling, use a wood, cork, sponge or felt-covered float to bring sand particles to surface to produce a pleasing, durable sand finish.

Application, Keenes Cement-Lime Finish—For medium hard finish, mix proportion of 100 lb. lime putty (50 lb. of dry hydrated lime) to 100 lb. Keenes Cement. For a hard finish, use 50 lb. lime putty (25 lb. dry hydrated lime) to 100 lb. Keenes Cement. Apply finish coat over a set basecoat that has been broomed and is partially dry. Spray with water if surface is too dry but do not soak. Scratch in thin coat and then double-back with second coat to a true surface. Trowel with water to a smooth, glossy finish, free from blemishes, until finish has set.

(See Chapter 4 for lime-gauging ratios and coverage.)

Gauging Plasters—Technical Data

product	set time with lime putty (min.)
CHAMPION (white)	20-30
STAR (white)	40-60
RED TOP Gauging (local-gray)	slow set 50-75 quick set 30-40
RED TOP Keenes Cement (white)	regular 180-360 quick set 60-120
STRUCTO-GAUGE (white or light gray)	slow set 60-75 quick set 30-40

finish limes

The two types of finish lime are: (1) *Type S* (also called autoclaved, pressure or double hydrate); (2) *Type N* (also called normal or single hydrate). Both produce a good finish lime putty, but their preparation differs. Weather precautions:

In Cold Weather—A few precautions will result in improved quality and easier working. Where weather and water are cold, lime develops better plasticity when soaked overnight. Best conditions are a warm room and water temperature over 50°F (10°C).

It is important to note that in cold weather the lime putty-gauging mixture requires a longer time to set. Therefore, gauging content should be increased or quick-set gauging added to offset the slower setting time.

Proper heat and ventilation are *musts*. Windows should be opened slightly so that moisture-bearing air moves out of the building. Fast drying after setting is essential to a hard finish.

Many cold-weather problems with finish lime are a direct result of improper basecoat conditions. Finish should go over a set, fairly dry basecoat. Since the basecoat will dry slowly in winter, heat and ventilation are needed. The water retentivity of lime putty, plus a cold, "green" base, does not provide enough suction to remove excess moisture. Blistering and cracking can occur due to slow set, or the lime may work back through set of the gauging.

In Hot Weather—Precautions include proper soaking of lime putty. When the sun is hot, hydrated lime requires ½ to 1 gal. more water per 50 lb. The water should be cool. Soaking of putty in shade prevents undue water evaporation and helps to prevent curdling and loss of spreading properties. Avoid soaking for periods longer than two or three days.

For application of lime putty-gauging finish plaster, make sure that basecoat is set and partially dry. If applied over a dried-out basecoat, water will be drawn from the finish coat, resulting in severe check-cracking. Spray the basecoat before finish coat application and trowel coat until final set.

IVORY and SNOWDRIFT Finish Lime—Autoclaved (double-hydrate). *Mixing*—Machine equipment must be clean. Place 5½ to 6 gal. clear water per 50-lb. bag of lime in mixer. Using a motor-driven, propeller-type mixer, the complete mixing of lime putty takes 2 to 3 min. and results in a high-quality, easy-working putty. Machine-mixed putty is plastic and coverage is increased from 10% to 15%. With a paddle-type mixer, the mixing time is about 15 min. *Hand Mixing*—For immediate use, place 5½ to 6 gal. water per 50 lb. IVORY or SNOWDRIFT Finish Lime in mixing box. Add finish lime to water and hoe sufficiently to eliminate lumps. Screen putty through 8-mesh screen before using. *Overnight Soak*—Place water hose in bottom of a level soaking box. Run water continuously while sifting lime through screen into water. When lime is soaked in this manner, there should be a small amount of excess water over top of lime. If excess water remains on the surface the following morning, absorb excess water by screening in additional IVORY or SNOWDRIFT Lime, allow to soak a few minutes, then blend into putty by hoeing. For use, screen through 8-mesh hardware cloth and mix with gauging plaster that meets job requirement. *Application* follows directions for Gauging Plasters.

RED TOP and GRAND PRIZE Finish Limes—Hydrate. *Machine Mixing*—Produces a smoother, more plastic putty, easier to use and with better coverage. Use approx. 6 gal. water to each 50-lb. bag of RED TOP or GRAND PRIZE Finish Lime. Mix lime and water to soupy consistency and then pour into soaking box.

Soak mix for min. of 16 hrs. to develop maximum workability and plasticity. Screen mix through 8-mesh hardware cloth to assure smooth, lump-free putty. *Hand Mixing*—Slowly sift RED TOP or GRAND PRIZE Lime into water in soaking box. Allow material to take up water for about 20 or 30 min. and then hoe briskly to mix thoroughly. Let mix soak for min. of 16 hrs. to develop full workability and plasticity. For use, screen through 8-mesh hardware cloth and mix with gauging plaster that meets job requirements. *Application* follows directions for Gauging Plasters.

special plasters and additives

Portland Cement-Lime Plaster—Used for interiors where high-moisture conditions exist such as in steam rooms, dairies, showers, etc. Also used as basecoat for exterior stucco.

Surface Preparation—Monolithic concrete surfaces should be brush-cleaned of all dust, loose particles and other foreign matter. Remove all laitance and efflorescence by washing with a 10% solution of commercial muriatic acid and water, then rinsing well with clear water. Remove grease or form oil by wiping with naphtha spirits. A high-quality plaster bonding agent should be applied to all surfaces according to manufacturer's directions.

Limitations: (1) Scratch, brown and finish coats require curing with water after set. (2) Must not be applied directly to smooth, dense surfaces, gypsum lath or gypsum block. Self-furring metal lath must be secured to such surfaces before plaster is applied. (3) Control joints should be provided to compensate for shrinkage during drying. (4) A Keenes Cement-Lime Putty Finish must never be used over a portland cement basecoat.

Job-Mixed Stucco—Mix BONDCRETE or MORTASEAL Lime with portland cement and sand in accordance with ANSI A42.2, Type L and in the following proportions:

coat[1]	mix					
	portland cement		BONDCRETE or MORTASEAL lime		sand[3]	
	lb	kg	lb	kg	ft^3	m^3
scratch	94	43	40-50[2]	18-23[2]	5-6[2]	0.14-0.17
brown	94	43	50	23	6-7[2]	0.17-0.20
finish	94	43	100	45	7-10	0.20-0.28

[1]Curing with water after set required in accordance with local codes. [2]Upper end of range for use over concrete block where greater water retention and plasticity are required; lower end of range for use over metal reinforcing mesh with exterior sheathing or building paper. [3]Quantity used varies, depending on shape and size of local sand particles.

Prepared Finish—ORIENTAL Exterior Finish Stucco requires addition of water only. Do not add waterproofing or antifreeze compounds, sand, or other materials. All tools and equipment must be clean.

Measure water accurately. To insure color uniformity, use the same amount of water for each batch mixed.

Do not overtrowel, as this may cause color to concentrate unevenly on the surface.

For mechanical mixing, add 100 lb. ORIENTAL Finish to 3 gal. water and mix for approx. 3 min. If more than one mixer load can be applied within three hours, mix entire amount, dump into box and blend to uniform color.

For hand mixing, add 100 lb. ORIENTAL Finish to 3 gal. water and allow to soak for approx. 15 min. Then hoe thoroughly to smooth consistency. If more than one batch can be applied within three hours, blend several batches together.

Hand Application—Apply ORIENTAL Finish only over a portland cement-lime and sand basecoat that is level but left rough under the darby, or broomed and properly cured.

Water-spray basecoat to provide a uniformly damp "partially green" surface. Remove loose and projecting particles from basecoat. Then apply a thin coat well-ground into the base and completely covering it. Double-back and fill out to uniform

Solid keying of ORIENTAL Exterior Stucco in machine-spray application assures high strength of finish.

thickness of about 1/8". Cover total area in one operation to eliminate joinings. Trowel three or four times before texturing.

For a float finish, use a cork, wood, carpet or sponge-rubber float and work surface to an even texture, free from blemishes, as the material stiffens and starts to set. Floating must be done without use of additional water.

Machine Application—ORIENTAL Exterior Finish Stucco may be applied in a single- or two-coat operation. Excessive mixing water should not be used as this may result in "lime bloom." For one-coat application, spray-apply material to basecoat to uniform thickness of approx. 1/8". Work from wet edges to complete an entire unbroken area in one continuous operation to eliminate joinings. For two-coat application, apply first coat with a trowel as in hand application. After troweling uniformly level, apply textured second coat, machine-spraying to total thickness of approx. 1/8".

After setting, fog-spray surface with water periodically for several days to cure the finish and help to prevent glazed spots and "bloom." Apply as much water as is readily absorbed. Frequency of spraying will depend on the weather.

RED TOP Retarder and RED TOP Accelerator—Available for use with plaster when required by job or climatic conditions. When used in excess, setting and drying problems can arise. Avoid use of too much retarder which can weaken the plaster finish.

Drying—Proper drying of conventional plaster surfaces is important to their ultimate performance. Rapid drying after the plaster has set is good because it produces high strength. Drying too fast before the plaster has set may leave insufficient water for the chemical reaction needed to properly set plaster. For standard plasters, slow drying should be avoided because it may cause "sweatout" and reduce strength. Proper ventilation should be provided to remove moisture-laden air.

ornamental plastering

For complete information, contact Dept. 440, Tooling & Casting Division, United States Gypsum Company, 101 S. Wacker Drive, Chicago, Ill. 60606.

special applications

replastering old plaster surfaces

In plastering over old plaster surfaces, certain precautions should be exercised to insure a satisfactory result. Generally, the old surface is lime plaster on wood lath, is badly cracked, and usually has been covered with canvas and/or multiple coats of paint.

The following suggestions for lathing and plastering over such old surfaces are listed in order of preference for best results:

1. If the old plaster and lath are removed, 3/8″ ROCKLATH Plaster Base may be applied to the framing and plastered in the same manner as for new work, following all applicable specifications.

2. If the old lath and plaster are left in place, the following methods may be used, after determining that the framing is of adequate size to carry the additional weight of a new plaster finish (average 8 lb./ft.²).

(a) Apply 1×3 furring strips 16″ o.c. with 12d 9-ga. nails, 3¼″ long or of sufficient length to achieve 1¾″ min. penetration into framing. Then apply 3/8″ ROCKLATH Base and plaster in same manner as specified for new work.

(b) Apply 3.4-lb. self-furring diamond mesh metal lath over old surface by nailing through into framing, using 2″ 11-ga. 7/16″-head barbed-shank galvanized roofing nails, 6″ o.c. Wire-tie side and end laps. Apply plaster in three coats. Use RED TOP Wood Fiber Plaster without addition of aggregate for scratch coat, and for brown coat with max. 1 cu. ft. of sand per 100 lb. of plaster. RED TOP Gypsum Plaster can be used with max. 2 cu. ft. of sand for scratch coat, max. 3 cu. ft. of sand for brown coat, or with 2½ cu. ft. of sand for scratch and brown coats. Lightweight aggregate should not be used in replastering when using metal lath.

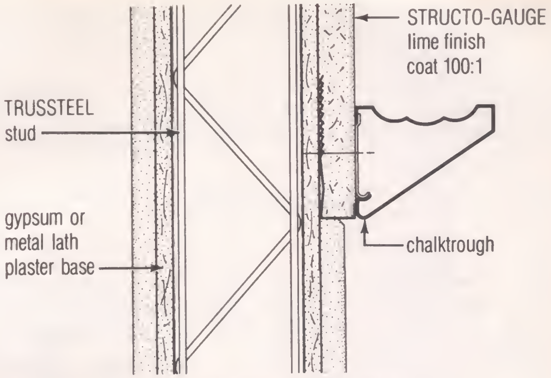
3. If the old plaster is removed and wood lath left in place, all loose laths should be renailed and the lath repeatedly sprayed with water over a period of several hours in order to wet thoroughly. Then replaster as specified in 2(b). *Note:* If wood lath is not thoroughly nailed and wetted, cracking of the plaster may occur. Finish coat may be smooth trowel or sand float, as desired, mixed and applied per applicable specifications.

integral plaster chalkboards

Plaster chalkboards offer definite design advantages. There is no limiting sheet size as is the case with fabricated boards; therefore, entire walls can be utilized as chalkboards. Maintenance is accomplished as easily as with conventionally fabricated chalkboards. Plaster chalkboards may be used with most plastered partition systems.

Chalkboard with TRUSSTEEL Stud Partitions—Follow general directions for system construction. Fasten floor and ceiling runner tracks in place and set TRUSSTEEL Studs 16″ o.c. Toggle bolts installed after plastering may be used for chalk and eraser-trough clips. Attach ROCKLATH Plaster Base or metal lath and install No. 66 Expanded Flange Casing Bead, stapling to plaster base or wire-tying to metal lath, 8″ o.c. Plumb and level all casing bead installations.

Mix STRUCTO-BASE Plaster in proportion of 2 cu. ft. sand per 100 lb. plaster; apply to ¾″ grounds. Finish with STRUCTO-GAUGE Gauging-lime mixed 100 lb. gauging per 100 lb. lime; apply to max. 1/16″ thickness.



cross-section thru chalkboard

Paint chalkboard when dry, with one coat primer-sealer and two coats chalkboard paint of quality equal to that of Lowe Bros., Pittsburgh Paints, Sherwin-Williams or Glidden.

door frames

Hollow metal door frames are shop-fabricated of 16-ga. and 18-ga. primed steel. Floor anchor plates of 16-ga. steel, with two anchor holes to prevent rotation, are welded to trim flanges to dampen door impact vibrations. Jamb anchor clips should be formed of 18-ga. steel, welded in the jamb and head.

Frames used with various plaster systems must be rigidly secured to the floor and partition construction to prevent twisting or other movement. If door frames are free to twist upon impact, cracking of plaster will result and eventually the frames will loosen. In addition to the framing specifications described, door closers are recommended on all oversize doors where the weight, including hardware, is over 50 lb.

Grouting of Door Frames—Always recommended, and *required* where heavy or oversize doors are used. As a grout, use a 100:2 RED TOP Gypsum Plaster-sand mix, adding enough water so that the material is stiff but workable. STRUCTO-LITE Gypsum Plaster is also suitable as grout, requiring only addition of water.

Under no condition should the lath and plaster terminate against the trim of the door frame. Grouting of exterior door frames with gypsum plasters is not recommended.

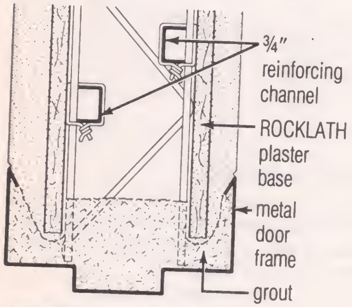
Control Joints—Also help prevent cracking of plaster at door frames. To break continuity of framing for control joint location, install door frame and place friction-fit cripple studs next to frame uprights. Allow ¼″ clearance for USG Control Joints Nos. 50, 75 and 100. Continue with plaster base application using required control joint at break in framing above door frame.

Door Frames with TRUSSTEEL Stud-ROCKLATH Partitions—Should be fabricated as described in previous sections. Insert studs into the steel door frame, nest in notches of jamb anchor

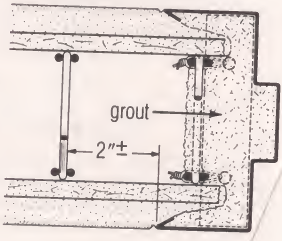
clips, and securely wire-tie stud flanges to each jamb anchor. Install a second stud each side of door frame, approx. 2″ from strut-stud.

Position two ¾″ cold-rolled channels over door head, extending out to engage the third stud on each side. Wire-tie these channels securely inside of stud chord at each intersection.

metal door frame

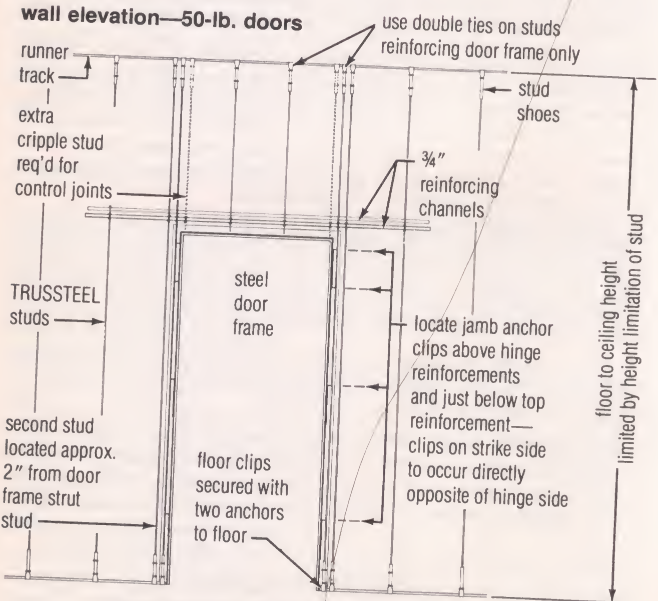


head-direct attachment



jamb-direct attachment

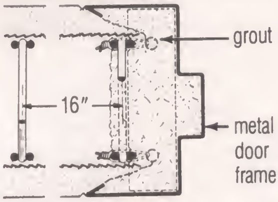
wall elevation—50-lb. doors



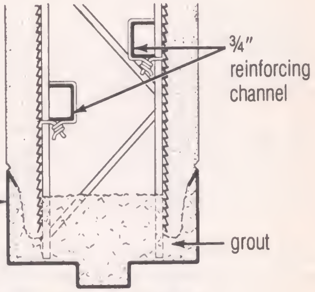
Note: See U.S.G. technical literature for reinforcing requirements of doors over 50 lb. and up to 200 lb.

Door Frames with TRUSSTEEL Stud-Metal Lath Partitions—Fabricate as described in previous section and erect frame supports. With metal lath, second stud adjacent to frame strut is not needed.

metal door frame

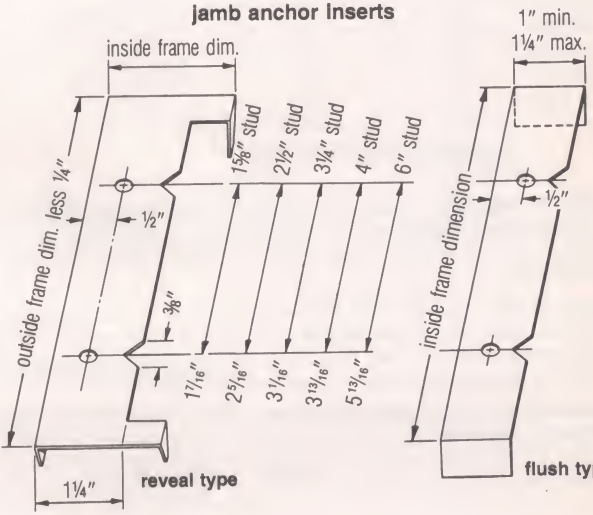


jamb-direct attachment



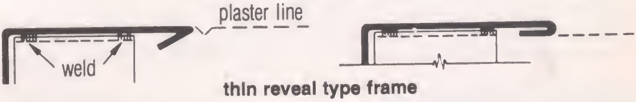
head-direct attachment

jamb anchor inserts

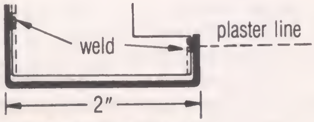


reveal type **flush type**

metal door frame reveals

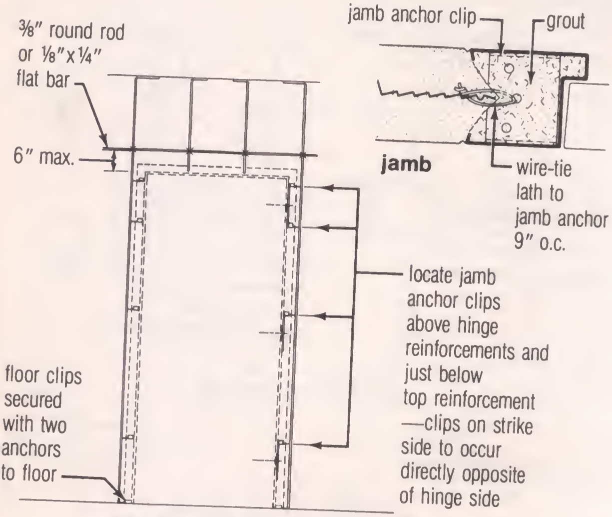


thin reveal type frame



std. reveal type frame

Door Frames with Studless Metal Lath Partitions—Follow general directions for fabricating door frames. Use four jamb anchors on each jamb and wire-tie to support frame.



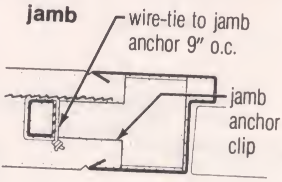
cross-section thru frame

Door Frames with Channel Stud-Metal Lath Solid Partitions—Fabricate as previously described with four jamb anchors welded to trim returns. Anchor frame to floor with power-driven fasteners.

Insert studs into steel door frame. Nest studs in notches of jamb anchor clips and wire-tie. Install a ⅜″ round rod or a ⅛″×1¼″ flat bar across head of door, extending to engage first stud beyond frame. Wire-tie bar at each channel intersection.

Grout steel door frames solid with mortar when scratch coat of plaster is applied.

Note: See frame elevation (studless metal lath partitions) for location of jamb anchors



caulking procedures

Where a plaster partition is used as a sound barrier, USG Acoustical Sealant should be used to seal all cutouts and all intersections with the adjoining structure. Caulking at runners and around the partition perimeter between gypsum lath and/or plaster and the structure is required to achieve sound transmission loss values on the job that approximate those determined

by test. Caulking has proven to be the least expensive way to obtain better sound control.

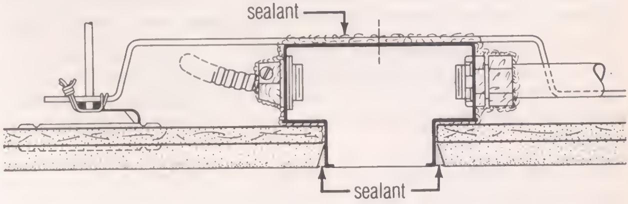
The surfaces to be caulked should be clean, dry and free of all foreign matter. Using an air-pressure-activated or hand caulking gun, apply USG Acoustical Sealant in beads about ⅜″ round.

Partition Perimeters—When gypsum lath is used, leave a space approx. ¼″ wide between lath and floor, ceiling and dissimilar walls. Appropriate metal edge-trim or casing beads applied to the lath may be used to create this space. Fill groove with USG Acoustical Sealant.

When conventional plaster is applied to metal lath, rake out plaster to form a ⅜″ groove at partition perimeter, and fill groove with acoustical sealant. Finish over groove with base or trim as desired.

Openings—Apply a ⅜″ min. round bead of acoustical sealant around all cutouts such as at electrical boxes, medicine cabinets, heating ducts and cold-air returns to seal the opening.

Electrical Fixtures—Apply caulking to the backs of electrical boxes and around all boxes to seal the cutout. Avoid cutting holes back to back and adjacent to each other. Electrical boxes having a plaster ring or device cover for use as a stop for caulking are recommended.



outlet box

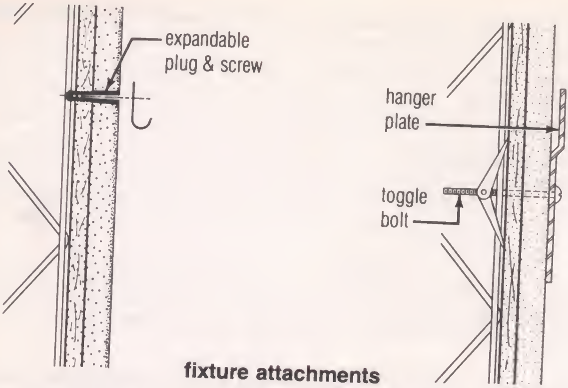
fixture attachment

Plaster partitions provide suitable anchorage for most types of fixtures normally found in residential and commercial construction. To insure satisfactory job performance, evaluation of load requirements of unusual or heavy fixtures and pre-construction planning are needed so that attachments will be within the load-carrying capacity of the construction.

The carrying capacity of a given attachment depends upon the strength of the plaster used. Plaster having a compressive strength of at least 900 lb/in² was used to develop the data shown in the Fastener Load Table at the end of this section.

The attachment of fixtures to sound-barrier partitions may impair the sound-control characteristics desired. Refrain from attaching fixtures to party walls so as to avoid a direct path for sound flow. Plastered ceilings are not designed to support light fixtures or troffers, air vents or other equipment. Separate supports should be provided.

In wood-frame construction, fixtures are usually attached directly to the framing or to blocking supports attached to the



fixture attachments

framing. Blocking or supports should be provided for plumbing fixtures, towel racks, grab bars and similar items. Lath and plaster membranes are not designed to support loads imposed by these items without additional support to carry the main part of the load.

To provide information for proper construction, an investigation of loading capacities of various fasteners and fixture attachments used with plaster partitions was conducted at the U.S.G. Research Center. These fasteners and attachments were tested:

Picture Hooks—A flattened wire hook attached to the wall with a nail driven diagonally downward. Depending on size, the capacity varies from 5 to 50 lbs. per hook. Suitable for hanging pictures, mirrors and other lightweight fixtures from all plaster partitions.

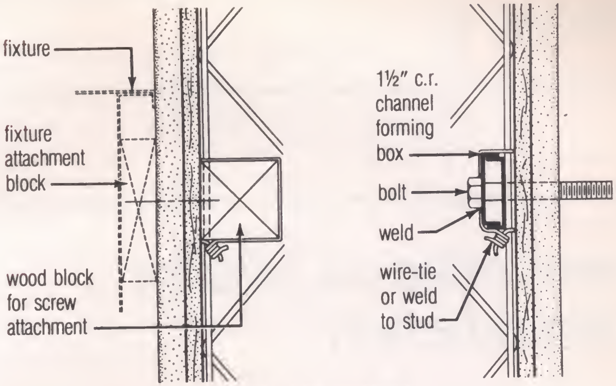
Fiber and Plastic Expansion Plugs—A sheet metal or wood screw driven into a fiber or plastic plug. Annular ribs are provided on outside of plastic plug to assure a positive grip in wall. As screw is inserted, rear end of plug expands and holds assembly in place. Suitable for attaching lightweight fixtures in all partitions.

Toggle Bolts—Installed in lath and plaster only. Disadvantages of toggle bolt are that when bolt is removed, wing fastener on back will fall down into a hollow wall and a large hole is required to allow wings to pass through wall facings.

Molly Bolts—Installed in lath and plaster only. One advantage of this type fastener is that threaded section remains in wall when screw is removed. Also, widespread spider support formed by the expanded anchor spreads load against wall material, increasing load capacity.

Bolts and 1½″ Channels—Two 5/16″ bolts welded to 1½″ channels for use in mounting hanger brackets for heavy fixtures. Two nested channels are securely attached to back of studs in steel-framed partitions.

Angle Brackets—Standard 10″×12″ shelving brackets spaced 24″ o.c. and fastened to wall with three-hole anchorage. Fastened to steel studs with sheet metal screws or to lath and plaster with toggle or molly bolts.



fixture attachments

Slotted Standards—With adjustable shelf brackets, are fastened 24" o.c. to steel studs with sheet metal screws or to lath and plaster with toggle or molly bolts. Normal standard spacing: 24" o.c. for 24" stud spacing, and 32" o.c. for 16" stud spacing. Limited to six shelves per partition height.

Separate Supports—Individual carriers or chairs placed in the core wall, recommended where heavy bathroom fixtures such as lavatories and water closets without floor supports are required.

Fixture Attachment Load Data—Lath and Plaster Construction

fastener			substrate	allowable withdrawal resistance		allowable shear resistance	
type	size			lbf	N(1)	lbf	N(1)
Plug and Screw	# 6		metal or gypsum lath and plaster	10	45	40	178
	# 8			20	89	50	222
	#12			30	133	60	267
	in	mm					
Molly or Toggle Bolt	⅛	3.2	metal or gypsum lath and plaster	75	334	50	222
	3/16	4.8		125	556	140	623
	¼	6.4		175	778	150	667
Plumber's Bracket Bolted to 1½" Channel	5/16	7.9	see drawing			300	1334

(1) Newton.

insulating blankets

See Chapter 1 for data on THERMAFIBER Insulating and Sound Attenuation Blankets for use in sound-rated assemblies.

decorating

See Chapter 1 for data on U.S.G. texture finish products.

chapter 6

conventional plaster construction

system performance and installation

system descriptions

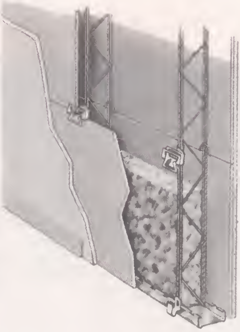
Fire and Sound Tests; HUD Standards

For information on these subjects, refer to U.S.G. technical literature.

Wood Stud Partitions

Suitable for residential and light commercial construction, these designs include those with direct-applied gypsum plaster base, and with direct-applied metal lath. Performance values of up to 2-hr. fire resistance and 53 STC can be obtained.

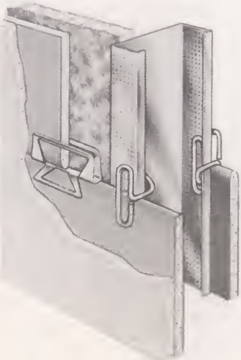
TRUSSTEEL Stud Partitions



These designs provide strong, lightweight, non-load bearing assemblies, suitable for virtually all types of construction. They include those with gypsum and metal lath, and those with direct and resilient attachment.

The open web of the truss design provides maximum chase space for horizontal, vertical or diagonal placement of pipes and electrical conduit. Also, web members can be cut to accommodate larger ducts without seriously impairing the strength of the partition construction.

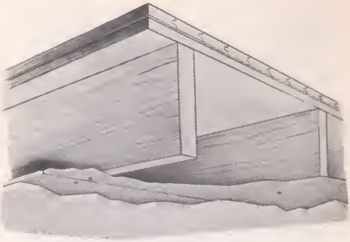
USG Steel Stud Partitions



These designs have strong appeal wherever a strong plaster finish is desired but speed and economy also are major factors.

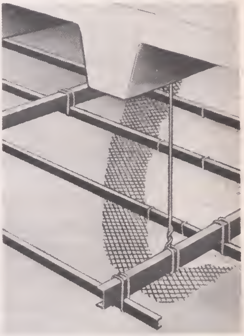
For both of the designs tested, the lath was attached with USG MS-1 Clips. However, it is virtually certain that code bodies would allow attachment with 1″ USG Type S Screws, 2 per 16″ width, 2″ from edges. Also, ½″ ×24″×96″ Long-Length ROCKLATH Base can be installed over steel studs 24″ o.c. and attached with three 1″ Type S Screws per stud.

Wood Frame Floor/Ceilings



Suitable for residential and light commercial construction, these assemblies attain fire ratings of 1-hr. and a range of sound ratings.

Noncombustible Floor/Ceilings



These ceiling systems consist of suitable metal framing, either furred or suspended, and ROCKLATH Plaster Base or USG Metal Lath attached and plastered according to specific requirements.

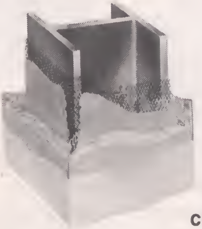
The furred ceiling framing follows the contour of the ceiling construction since it is fastened directly to overhead framing. A suspended ceiling consists of a metal channel framework hung from the structure above.

Both framing systems provide a means of support for the plaster base at closer intervals than is offered by the ceiling assembly itself and are adaptable to virtually all types of construction.

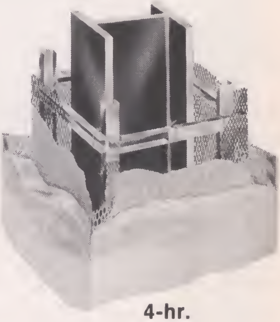
The furred system provides support of metal lath at close intervals yet allows space between joists for pipes, ducts, conduits or insulating material.

The suspended system provides a fireproof membrane to hide pipes, ducts and conduits and is adaptable to complex contours for acoustical treatment, unique decorative or lighting effects.

Structural Fire Protection



3-hr. column



4-hr. column

Membrane fire protection is the term applied to the use of a thin, lightweight layer of lath and plaster to provide protection for

the structural elements of a building. USG Metal Lath makes possible low-cost fire resistance, meeting nearly any fire rating desired. It permits the designer to use lighter structural members, floors and footings than in buildings using masonry or concrete fireproofing.

The fire resistance of the various assemblies depends on the type of plaster base, its method of attachment and spacing, and the type and proportion of aggregate to gypsum plaster and thickness.


3-4 hr. caged beam

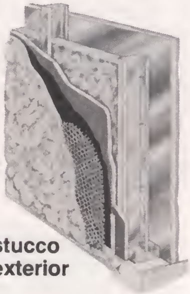
USG Curtain Walls

USG Curtain Wall Systems offer a wide range of architectural effects for non-load bearing exterior walls. Fabricated on the job from conventional components, these low-cost, lightweight, non-load bearing assemblies are suitable for both concrete and steel frame construction.


masonry exterior

Framing—The standard curtain wall system uses USG Steel Framing or CWS studs with THERMAFIBER Curtain Wall Insulation CW-40 or Metal Stud Blankets inserted in cavities between studs. A variety of exterior finishes can be applied to meet design requirements. With this system, U.S.G. publishes wall heights to 26′0″ and wind loads to 40 psf. For additional information refer to USG Curtain Wall Systems Folder SA-805.

An alternate framing system uses USG C-H Studs, J-Runners and Gypsum Liner Panels.


stucco exterior

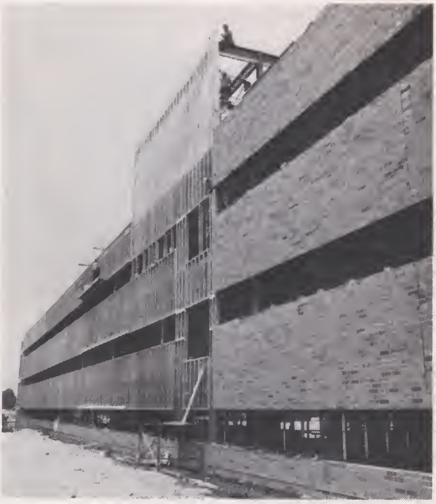
Exterior Lath Installation—Apply self-furring metal lath over gypsum sheathing and No. 15 asphalt felt with long dimension across steel studs, with ends lapped 1″ and staggered in adjacent courses, with sides lapped ½″. Screw-attach lath through gypsum sheathing to steel studs and runners with 1¼″ Type S or S-12 Pancake Head Cadmium-plated Screws 8″ o.c. Attach gypsum sheathing to steel studs with 1″ Type S or S-12 Bugle Head Screws-Cadmium plated. On exterior curtain wall applications, use Type S screws with 22-20 ga. steel studs, Type S-12 screws with 18-14 ga. steel studs.

Control Joints—Install USG Control Joint No. 100 where indicated on drawings. Back control joints with 2″ wide butyl tape applied to the sheathing. Install joints with flanges under self-furring lath and attach with Bostitch 9/16″ "G" staples or equal, spaced 6″ apart on each flange. Break supporting members, sheathing and metal lath behind control joints. Apply sealant at all splices, intersections and terminals.

Beads and Trim—Use corner bead, casing bead and trim fabricated from zinc alloy only; do not use galvanized accessories. Provide small weep holes for casing beads installed with the flange up. Fasten beads and trim securely 8″ o.c. by stapling to gypsum sheathing or wire-tying to metal lath. Galvanized fasteners are recommended.

Stucco Exterior—To relieve stresses in portland cement-stucco exterior surfaces, install USG Control Joint No. 100 spaced no more than 10 ft. apart with a maximum area of 100 sq. ft. Apply portland cement-lime stucco in scratch and brown coats to full 1″ thickness. Apply scratch coat with sufficient material and pressure to form good full keys on metal lath, then cross-rake. After scratch coat has set firm and hard, apply brown coat to full grounds and straighten to a true surface. Leave rough for finish coat or matrix application or seed aggregate before brown coat has set.

Masonry Exterior—Install masonry per architect's specifications and details. Anchor brick to channel-type steel studs with approved brick anchors screw-attached through gypsum sheathing to studs with Type S or S-12 Pancake Head Screws (cadmium-plated). Space anchors to recommendation of Brick Institute of America. On exterior curtain wall applications, use Type S screws on 22-20 ga. steel studs and Type S-12 screws with 18-14 ga. steel studs.



Panel Exterior—Apply ceramic, aggregated or porcelain enamel panels, prefinished metal siding and other dry exterior facings weighing up to 8 psf over gypsum sheathing and screw-attach to channel-type studs. Use stainless steel or cadmium-plated screws spaced according to panel manufacturer's recommendations. Screws should not transfer more than 15 lbs. panel weight


USG Curtain Wall Systems offer a wide range of exterior treatments

per screw to the studs. Choose screw length based on panel thickness plus 7⁄8″.

Insulation—Install fire-protective THERMAFIBER Mineral Wool Blankets between studs. Fit blankets carefully to fill entire height of stud cavity. Attach blankets to gypsum sheathing using 9⁄16″ staples with divergent points placed at each corner and in the center of each blanket, or hold MS Blankets tightly against metal lath backing with taut horizontal tie wires spaced no more than 36″ o.c. Install a separate vapor retarder such as foil-back gypsum lath when using stud blankets.

THERMAFIBER MS Blankets are friction-fitted between studs in curtain wall assembly, then staple-attached to gypsum sheathing.

Install THERMAFIBER Curtain Wall Insulation either by press-fitting or attaching mechanically. Install foil-faced blankets with foil facing inward. Butt ends and edges to fill all voids.

Install THERMAFIBER Safing Insulation in all voids between floor slab and curtain wall by inserting on support brackets or impaling on clips 24″ o.c.

Lath and Plaster Interior—Foil-Back ROCKLATH Plaster Base (perpendicular application) is screw-attached to steel studs with 1″ Type S Screws, using 3 screws per stud. RED TOP or STRUCTO-LITE Gypsum Plaster is applied to 7⁄16″ grounds over the lath followed by a 1⁄16″ finish plaster application.

For more data, see USG Curtain Wall System Folder SA-805.

Rapid erection sequence includes steel stud installation and gypsum sheathing attachment (above), or tilt-up of preassembled sections (left). Typical curtain wall exterior appears below.

chapter 7

common problems–equipment–appendix and glossary

problems, remedies and preventive measures

factors affecting results

Today's proven-quality products and high-performance systems permit installation of attractive, durable, trouble-free interiors which meet designers' specifications and owners' needs. By using correct installation procedures and equipment, the contractor can combine these products into systems, with profitable results. Problems, should they occur, not only cause customer dissatisfaction but also reduce productivity, require callbacks and lower ultimate profit.

Potential problem areas which will produce unsatisfactory results are defined in this chapter. Common problems related to product application are described, together with appropriate remedies and preventive measures for future work. Corrective action, taken promptly, will resolve these problems with the least amount of effort and added cost.

Selection of Materials

In recent years, technological advances in building construction have resulted in a great number of new products and systems. Each requires systematic evaluation of performance and appearance characteristics in relation to cost, before selection and use. Evaluation may be done through benefit-cost analysis or life-cycle cost analysis which considers the total cost of an assembly throughout its useful life. Building materials selection should always be based on total performance, including maintenance, and not simply on initial construction cost or a budgeted cost figure. The following items merit consideration in systematically selecting products and systems for gypsum construction.

satisfy user needs

To satisfy the owner's functional requirements, it is basic to match products and systems to the end performance desired. For instance, high-traffic areas such as corridors may require hard-wearing, abuse-resistant surfaces available with high-density products. Where quiet surroundings or isolation from noise is needed, systems with high resistance to sound transmission and surfaces that provide sound absorption are essential. Predecorated, low-maintenance surfaces may be justified in the form of vinyl-faced gypsum panels. In common walls between apartments, where greater core widths are needed to enclose plumbing lines, a system with adequate space in the cavity is called for. The objective is to always select products and systems that will improve the total performance of the building components.

meet regulatory requirements

The performance of gypsum construction products and systems most often must comply with regulatory requirements established by local, state and federal agencies. Local and state

building codes, HUD (FHA) Minimum Property Standards, and insurance and lending agency requirements should be considered in material selection.

identify critical performance

In selecting appropriate materials, product or system limitations should be reflected. Structural factors, such as limiting height and span, required number of screws, metal thickness, bracing spacing or maximum frame and fastener spacing, should not be exceeded since they affect the flexural properties and strength of an assembly. Yield strength of all steel is not the same. Substitution by size alone is not recommended. System performance following any substitution of material or compromise in assembly design cannot be certified and may result in failure under critical conditions. It is important to note that extreme and continuous high humidity or temperatures may result in sag, joint deformation, poor appearance and possible deterioration of gypsum surface materials. Sealing and painting recommendations are important for proper performance of paints and other finishes.

establish performance requirements

Fire Resistance—Select fire-tested assemblies to comply with regulatory requirements and construct the assembly according to specifications. If an assembly does not comply, work may be halted by the building inspector, or installation may be rejected after completion.

Sound Control—Owner's needs and regulatory requirements dictate the sound control needed. Many assemblies are available to meet requirements (see Chapters 3 and 6). Sound test data is obtained under ideal laboratory conditions per ASTM procedures, except as noted. For assemblies to approach tested performance, strict attention must be given to construction details and installation. The isolation expected from an assembly can be negated by penetrations, perimeter leaks, accidental coupling of decoupled elements, incompatible surrounding structures and by other faulty installation practices.

Structural Strength and Stability—Select systems that provide adequate strength and acceptable deflection under live and dead loads as described in published U.S.G. performance tables. Shear or torque loads caused by shelving, sanitary basins, light fixtures and other accessories should also be considered. Shear forces from wind or earthquake may also require consideration. Cracking will probably occur in assemblies of insufficient strength or stiffness if adequate reinforcing is not provided.

Water and Moisture—Choose products and systems which offer adequate resistance to water and high-moisture conditions. Gypsum products are not suitable under conditions of extreme and sustained moisture. Products manufactured from steel or other materials subject to corrosion must have a protective coating equal to the service conditions envisioned.

Humidity and Temperature—Determine the environmental conditions to be expected during construction and use; select products that offer high performance under these conditions or control the job environment. Most gypsum products should be installed at temperatures above 55°F (13°C) and may gradually deteriorate under sustained temperatures over 125°F (52°C). High humidity and temperature may cause problems with veneer finishes, gypsum plasters and gypsum board products.

Durability—Properly selected gypsum products offer high compressive strength and surface hardness to resist damage from impact and abrasion, particularly the high-strength plasters and veneers. For long-lasting, problem-free interiors, select products to meet functional needs.

Appearance—Color, texture and surface gloss affect the final appearance of interior surfaces. Texture finishes offer a wide variety of effects for distinctive appearance. High-gloss finishes highlight surface defects; textures hide minor imperfections.

Cleanability and Maintenance—Select products according to functional requirements for washability and resistance to fading, staining and scuffing. Predecorated TEXTONE Panels offer a tough, stain-resistant vinyl surface easily cleaned with soap and water. Certain aggregated ceiling texture finishes cannot be washed but can be painted when redecoration is needed.

Light Reflection—Select colors and finishes to meet appearance standards, illumination levels and other functional requirements. Strong sidelighting from windows or surface-mounted light fixtures may reveal even minor surface imperfections. The light strikes the surface obliquely, at a very slight angle, and greatly exaggerates surface irregularities. These conditions demand precise installation, increase chances for callbacks and should be avoided. If critical lighting cannot be changed, the effects can be minimized with rough-surfaced texture finish or draperies and blinds which soften shadows.

Interface and Compatability—Materials that come into contact with each other must be compatible. Differences in thermal or hygrometric expansion, strength of substrates or basecoats in relation to finish coats, thermal conductivity and galvanic action are common situations which can cause problems. The subject is too complex to be covered in detail here. Specific manufacturers should be contacted for recommendations should questions arise. Following are some precautions of this kind associated with gypsum construction.

Gypsum surfaces should be isolated with control joints or other means where necessary to isolate structural movements, changes in shape, gross area limits and when abutting other materials.

Due to expansion differences, the application of high-pressure plastic laminates to gypsum panels or plaster is not generally satisfactory.

IMPERIAL Gypsum Base and regular SHEETROCK Brand Panels do not provide sufficient moisture resistance as a base for adhesive application of ceramic tile; use SHEETROCK Brand W/R Gypsum Panels.

Install resilient thermal gaskets around metal window frames to keep condensation from damaging wall surface materials. The gasket may also reduce galvanic action and resultant corrosion which occurs when two dissimilar metals contact in the presence of moisture.

Vapor Control—The use and proper placement of vapor retarders are extremely important in modern construction with its increased use of thermal insulation brought about by the need for energy conservation.

Inattention to proper placement or omission of a vapor retarder with thermal insulation may result in condensation in the exterior wall stud cavities. Cold climates require a vapor retarder on the warm interior side of the wall. For air conditioned buildings in climates having sustained high outside temperatures and humidity, a qualified mechanical engineer should determine location of the vapor retarder.

Two vapor retarders on opposite sides of single wall can trap water vapor between them and create moisture-related problems in the core materials.

When a polyethylene vapor retarder film is installed on ceilings behind gypsum panels, under cold winter conditions it is important to install the ceiling insulation before the board. Failure to follow this procedure can result in moisture condensation in the back side of the gypsum panels, causing the board to sag.

Handling and Storage

Even quality products can contribute to problems during application and job failures if these products are not protected from damage and improper handling. Generally, gypsum products should be stored inside at temperatures above freezing, protected from moisture and external damage, and used promptly after receipt on the job.

inspect on delivery

Products should be inspected for proper quantity and possible damage when they are delivered on the job. Incorrect quantities may result in job delays due to shortages or extra cost for overages that are wasted. Check products for physical damage such as broken corners or scuffed edges on gypsum board, wet board, bent or corroded steel studs and runners. Inspect containers for evidence of damage that may affect the contents. Look for damaged or torn bags which could result in waste, lumpy joint compound, preset plaster or veneer finishes. Report any damaged material or shortages immediately.

store in enclosed shelter

Enclosed protection from the weather is required for the storage of all gypsum products. Outside storage is not recommended. Various problems can result when these products get wet or are exposed to direct sunlight for extended periods.

Store gypsum boards flat on a clean, dry floor to prevent permanent sag or wavy-edged board. Vertical storage may damage edges or deform board. If board is stored on risers, they should be at least 4″ wide and placed directly under each other vertically, within 2″ of board ends and no greater than 28″ apart for 14-ft. board 23″ apart for 12-ft. lengths, 24″ apart for 10-ft. lengths, 21″ apart for 9-ft. lengths and 25″ apart for 8-ft. lengths.

Stack bagged goods and metal components on planks or platforms away from damp floors and walls. Corrosion on corner bead, trim and fasteners may bleed through finishing materials. Ready-mixed joint compounds which have been frozen and thawed repeatedly lose strength, which may weaken the bond.

protection from damage

Locate stored stocks of gypsum products away from heavy-traffic areas to prevent damage from other trades. Keep materials in their packages or containers until ready for use to protect them from dirt, corrosion and distortion. Damaged board edges are more susceptible to ridging after joint treatment. Boards with rough ends will require remedial action before installation; otherwise, deformation or blistering may occur at end joints.

use of fresh material

If possible, gypsum construction products should be ordered for delivery to the job just before application. Materials may become damaged by abuse if stored for a long period of time. Fresh plaster and veneer finishes should be received on the job frequently to minimize performance problems caused by variable moisture conditions and aging.

Job Conditions

Many problems can be directly traced to unfavorable job conditions. These problems may occur during product application or they may not appear until long after job completion.

Recommendations for proper job conditions, given in the appropriate product application chapters here, should be closely followed. If job conditions are unfavorable, correct them before product installation. The following environmental factors can present problems in gypsum construction.

temperature

Gypsum products should be installed at comfortable working temperatures above 55°F (13°C). In cold weather, controlled heat should be provided to keep the temperature in the range of 55° to 70°F (13° to 21°C). For example, if gypsum board were to be installed at a temperature of 28°F (−2°C), it will expand at the rate of ½″ for every 100 lin. ft. when the temperature is raised to 72°F (22°C). At lower temperatures, the working properties and performance of plasters, veneer finishes and joint compounds

are seriously affected. They suffer loss of strength and bond if frozen after application and may have to be replaced. Ready-mixed compounds can deteriorate from repeated freeze-thaw cycles, lose their workability and may not be usable. Avoid sudden changes in temperature which may cause cracking from thermal shock.

humidity

High humidity resulting from atmospheric conditions or from wet materials used on the job such as concrete, stucco, plaster and spray fireproofing often creates situations for possible problems. In gypsum boards, water vapor is absorbed which softens the gypsum core and expands the paper. As a result, the board may sag between ceiling supports. Sustained high humidity increases chances for galvanized steel components to rust, especially in marine areas where salt air is present. High humidity can cause insufficient drying between coats of joint compounds, which can lead to delayed shrinkage and/or bond failure. Jobs may be delayed because extra time for drying is required between coats of joint compound.

Low humidity speeds drying, especially when combined with high temperatures and air circulation. These conditions may cause dryouts in veneer finishes and conventional plasters. They also reduce working time and may result in edge cracking of the joint treatment. Crusting and possible contamination of fresh compound, check and edge cracking are also caused by hot and dry conditions. Under hot, dry conditions handle gypsum board carefully to prevent cracking or core damage during erection.

moisture

Wind-blown rain and standing water on floors increase the humidity in a structure and may cause problems defined above. Water-soaked gypsum boards and plasters have less structural strength and may sag and deform easily. Their surfaces when damp are extremely vulnerable to scuffing and damage.

ventilation

Ventilation should be provided to remove excess moisture, permit proper drying of conventional gypsum plasters and joint compounds and prevent problems associated with high-humidity conditions. For veneer finishes, to prevent rapid drying and possible shrinkage, poor bond, chalky surfaces and cracking, air circulation should be kept at a *minimum* level until the finish is set. Rapid drying also creates problems with joint compounds, gypsum plasters and finishes when they dry out before setting fully and, as a result, don't develop full strength.

sunlight

Strong sunlight for extended periods will discolor gypsum panel face paper and make decoration difficult. The blue face paper on veneer gypsum base will fade to gray or tan from excessive

exposure to sunlight or ultraviolet radiation. Application of finishes containing alkali (lime) to this degraded base may result in bond failure unless the base is treated with an alum solution or bonding agent.

Movement in Structures

Building frames today are much lighter in weight than former heavy masonry or massive concrete structures. Modern structural design uses lighter but stronger materials capable of spanning greater distances and extending buildings higher than ever before. While these frames meet current standards of building design, they are more flexible and offer less resistance to structural movement. This flexibility and resulting structural movement can produce stresses within the gypsum assemblies, which are usually non-load bearing. When these accumulated stresses exceed the strength of the materials in the assembly, they are relieved by cracking, buckling or crushing of the finished surface unless relief joints are provided to isolate these building movements.

Structural movement and the majority of cracking problems are caused by deflection under load, physical change in materials due to temperature and humidity changes, seismic forces, or a combination of these factors.

concrete floor slab deflection

Dead and live loads cause deflection in the floor slab. If this deflection is excessive, cracks can occur in partitions at the mid-point between supports. If partition installation is delayed for about two months after slabs are completed, perhaps two-thirds of the ultimate creep deflection will have taken place, reducing chances of partition cracking.

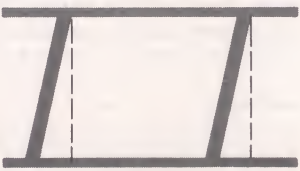
wind and seismic forces

Wind and seismic forces cause a shearing action on the building framework which distorts the rectangular shape to an angled parallelogram. This distortion is called racking, and can result in cracking and crushing of partitions adjacent to columns, floors and structural ceilings.

Wind blowing against a building exerts a positive pressure force on one side of the building and a negative pressure on the

Structural Movement

floor slab deflection



racking

opposite side. Because the building is secured to the ground, the greatest racking occurs at the upper floors.

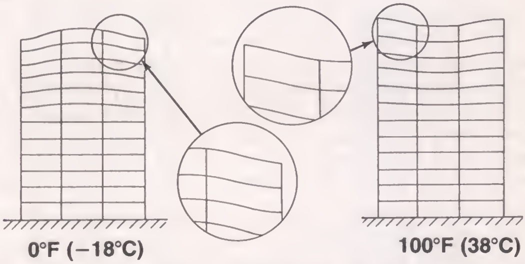
Earthquakes, caused by shock waves in the ground, produce a shearing action which tends to topple buildings. Initially the greatest racking occurs near the ground but as shock waves continue, the entire building framework is affected.

To resist this racking, building frames must be stiffened with shear walls and/or cross-bracing. Steel-frame buildings are diagonally braced with steel strapping. Wood-frame structures are strengthened with let-in cross-bracing and/or shear diaphragms of structural sheathing. On larger buildings, racking is resisted by shear walls and wind-bracing without considering the strength added by finishing materials. Moreover, the partitions must be isolated from the structure to prevent cracking caused by racking movement and distortion.

thermal expansion

All materials expand with an increase in temperature and contract with a decrease. In tall concrete or steel-frame buildings, thermal expansion and contraction may cause cracking problems resulting from racking when exterior columns and beams are exposed or partially exposed to exterior temperatures. Since interior columns remain at a uniform temperature, they do not change in length.

Exposed exterior columns can be subjected to temperatures ranging from over 100°F. to 0°F. (38° to −18°C), and therefore will elongate or contract in length. The amount of expansion or contraction of the exposed columns depends on the temperature difference and several other factors. (Structural movement caused by thermal differentials accumulates to the upper floors.) However, the stiffness of the structure resists the movement and usually, full unrestrained expansion is not reached.



Racking is greatest in the outside bays of upper floors in winter when temperature differentials are largest. To prevent major changes as described above, apply proper insulation to exterior structural members. The design should call for control joints to relieve stress and minimize cracking of surfaces.

hygrometric expansion

Many building materials absorb moisture from the surrounding air under high-humidity conditions and expand; they contract

during periods of low humidity. Gypsum, wood and paper products are more readily affected by hygrometric changes than are steel and reinforced concrete. Gypsum boards will expand about ½″ per 100 ft. with a relative humidity change from 13% RH to 90% RH (see Appendix for coefficients). Unless control joints are provided, hygrometric changes create stresses within the assembly which result in bowed or wavy walls, sag between supports in ceilings, cracking and other problems.

relief joints

Gypsum assemblies should be selected to provide the best structural characteristics to resist stresses imposed on them. As described previously, these systems must resist internal stresses created by expansion and contraction of the components and external stresses caused by movement of the structure. The alternative solution is to provide control and relief joints to eliminate stress buildup and still maintain structural integrity of the assembly.

To control external stresses, partitions and other gypsum construction must be relieved from the structural framework, particularly at columns, ceilings and intersections with dissimilar materials. In long partition runs and large ceiling areas, control joints are recommended to relieve internal stress buildup. Methods for providing relief and control joints are shown in Chapters 2 and 5. These recommendations provide for ¼″ relief and are for normal situations. Relief joints for individual structures should be checked for adequacy by the design engineer to prevent cracking and other deformations.

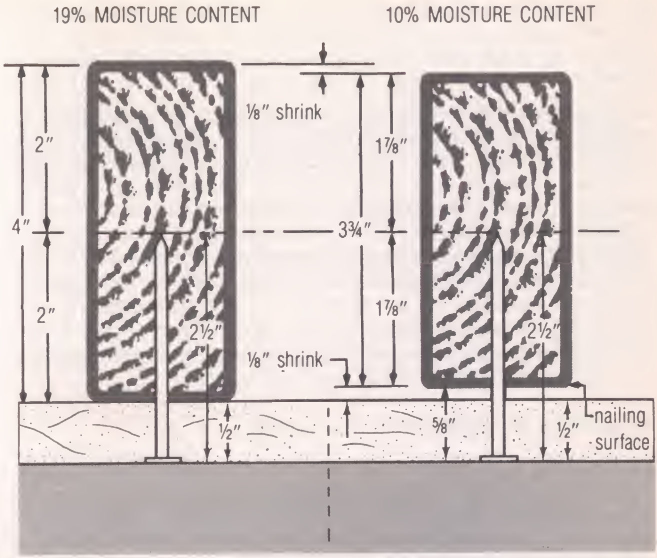
lumber shrinkage

In wood-frame construction, one of the most expensive problems encountered is fastener pops in drywall surfaces that are often caused by lumber shrinkage. Shrinkage occurs as lumber dries. Even "kiln-dried" lumber can shrink, warp, bow, and twist, causing board to loosen and fasteners to fail. Gypsum surfaces can also crack, buckle, or develop joint deformations when attached across the wide dimension of large wood framing members such as joists. Typically this installation occurs in stairwells and high wall surfaces where the gypsum finish passes over mid-height floor framing, as in split-level houses.

Framing lumber as commonly used has a moisture content of 15% to 19%. After installation, the lumber loses about 10% moisture content and consequently shrinks, particularly during the first heating season.

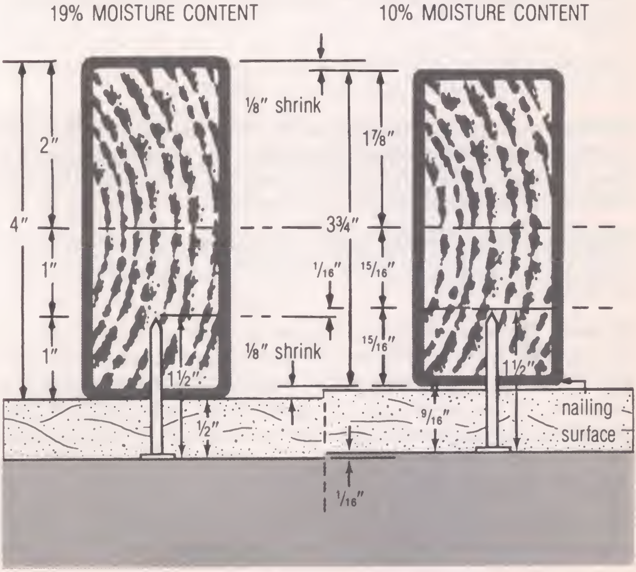
Wood shrinks most in the direction of the growth rings (flat grain), somewhat less across the growth rings (edge grain), and very little along the grain (longitudinally). Shrinkage tends to be most pronounced away from outside edges and toward the center of the member. When nails are driven toward the central axis, shrinkage leaves a space between the board and the nailing surface as shown in the drawing below.

Based on experiments conducted by the Forest Products Labo-



ratory and Purdue University, the use of shorter nails results in less space left between the board and nailing surface after shrinkage (shown below) than with longer nails having more penetration. Using the shortest nail possible with adequate holding power will result in less popping due to shrinkage.

The annular ring drywall nail, with an overall length of 1¼″, has equivalent holding power to a 1⅝″ coated cooler-type nail,



but the shorter length of the ring nail lessens the chances for nail popping due to lumber shrinkage. For additional information on nail pops, see U.S.G. technical folder CS-17, "Nail Pop Control in Gypsum Drywall."

Several preventive measures can be taken by contractors to minimize fastener failures and structural cracking resulting from lumber shrinkage. USG Type W Screws are even better than the ring nail because they develop 350% greater holding power and thus reduce possibilities for fastener pops. The floating interior angle system effectively reduces angle cracking and nail pops resulting from stresses at intersections of walls and ceilings. Gypsum boards should be floated over the side face of joists and headers and not attached. To minimize buckling and cracking in wall expanses exceeding one floor in height, either float the board over second-floor joists using resilient channels or install a horizontal control joint at this point.

cracking in high-rise structures

Contractors who install commercial partitions and ceilings should be aware of cracking problems caused by structural movement, deflection, expansion and contraction. These problems, described earlier, are usually not due to faulty materials. Anticipated structural movement in the frame and floor system should be taken into account in the design of the building. It is better to solve potential problems with preventive measures before installation rather than by attempted repairs afterward.

Some types of construction can be expected to cause cracking in gypsum assemblies if not handled properly. Following are clues to potential problems:

Flat Plate Design—Particularly with column bay sizes exceeding 20 ft.

Exposed Exterior Columns and Shear Walls—On buildings over 12 floors in height and located in a cold climate.

Reinforced Concrete Structures—Erected in cold weather, with partitions installed too soon thereafter. Creep deflection in the floor slab, a cause of partition cracking, is retarded in cold weather and accelerated in warm weather.

Structures Without Shear Walls or Proper Bracing—Particularly if the plan is long and narrow, presenting a large wall area to withstand wind load.

Gypsum Systems Without Expansion Joints—Long partition runs and large ceiling areas must have control joints to compensate for hygrometric and thermal expansion and contraction.

When one or more of these conditions exist, it is wise to notify the owner, architect and general contractor, by letter, of the indicated possible problems and recommend corrective measures that should be taken. In this way, if corrective action is not taken, fewer questions are likely to arise when problems occur. If corrective measures are effective, all involved will be rewarded with a satisfactory performance and costly complaints avoided.

structurally generated noise

Loads of varying intensity can cause structural movement which generates noise when two materials rub or work against each other. In high rise buildings, variable wind pressure can cause a whole structure to drift or sway, causing structural deformation. Such deformation imparts racking stresses to the non-load bearing partition and can create noise.

As another annoyance, lumber shrinkage often results in subfloors and stair treads squeaking under foot traffic. This squeaking can be avoided by using adhesive to provide a tight bond between components and prevent adjacent surfaces from rubbing together.

United States Gypsum Company assumes no responsibility for the prevention, cause or repair of these job-related noises.

Workmanship

U.S.G. products are quality-tested and job-proven for fast, economical installation and problem-free results. Unfortunately, sometimes these products fail to achieve optimum performance after installation—due to improper or unspecified application.

follow current directions

The major cause of job problems and poor performance after application is failure to follow manufacturer's directions and architect's specifications. Application procedures should be checked regularly to conform with current manufacturer's recommendations. Product modifications to upgrade in-place performance may require slight changes in mixing or application methods. New products may require the adoption of entire new procedures and techniques.

meet specifications fully

Building specifications are designed to provide a given result, but unless construction materials and methods are matched and the proper details followed, the actual job performance will probably fall short of requirements. Excessive water usage, oversanding, improper surface preparation, substitution of materials, skimping and shortcuts should not be tolerated because they inevitably lead to problems.

Equipment Selection

A large selection of equipment is available for gypsum construction and particularly for mechanical application of veneer and texture finishes, conventional plasters and joint treatment. The mechanical spray equipment chosen should be based on the type of material and the situations presented on each job. The size of the job, delivery volume required, portability and access

through doorways also deserve consideration. Low maintenance and accessibility of parts for cleanup are important factors.

Using the wrong equipment for the job can cause serious problems. Improper equipment not only affects production but also strength, workability, setting time and finished appearance.

Mixing—Equipment should provide the correct mixing action and mixing speed. Equally important are proportioning and mixing procedures required for the particular material as shown in Chapters 2 and 5. Poor mixing practices adversely affect material performance and can cause various problems.

Pumping—Equipment should have capacity sufficient for the job, hose size and pumping distance, and should be kept in good repair. To minimize abrasive wear in the pump mechanism, the pump type should be suitable for the aggregate and mixes being used. High plaster/sand ratios, small-diameter hoses and leakage increase the possibility of aggregate packing in the pump and hose. Use large-diameter hoses and no more hose length than needed. Small-diameter, long hoses cause pumps to wear faster and may lead to quick-set and low-strength problems in fluid materials.

Spraying—Nozzle or orifice size of the spray gun and air pressure used must be suitable for the material being applied. Improper nozzles and incorrect air pressures affect the spray pattern and may cause stoppage and aggregate fallout. With most veneer finishing, a catalyst tank with metering device is required to adjust setting time.

Product Quality

U.S.G. gypsum construction products provide the essential requirements of economy, problem-free installation and high performance in fire and sound-rated systems. During manufacture, these products are carefully controlled to meet specific performance standards when applied according to directions and under proper job conditions.

complaint procedure

Should a probable product deficiency appear, stop using the suspected defective material immediately and ask your supplier to notify U.S.G. at once so that a representative can investigate the complaint and take remedial action. Do not continue to use improperly performing materials, because at today's wages, the labor cost of replacement or reworking far exceeds the cost of the material.

sampling

For use in analyzing suspected materials, obtain samples of the material that fully represent the complaint condition. Save bags, wrappers and packages that will identify place and time of manufacture. For some complaints it also is necessary to obtain

samples of related materials such as aggregates. Weather conditions, mixing times and proportions of ingredients should be fully reported.

substitution and certification

U.S.G. will provide test certification for published fire, sound and structural data covering systems designed and constructed according to its specifications. Tests on U.S.G. products are conducted to meet the exact performance requirements of established test procedures specified by various building code agencies. Any substitution of materials or compromise in assembly design cannot be certified and may result in failure of a system in service, especially under critical conditions of load or fire exposure.

How to Inspect a Job

Proper job inspection during installation many times reveals potential problem areas or procedures that will produce unsatisfactory results. Corrective action taken immediately is usually less costly than callbacks to repair and perhaps rebuild walls and ceilings after the job is completed.

A complete understanding of job details, schedules, and specifications is necessary to conduct proper inspection. If the assembly is to meet fire and sound-rating requirements, then construction details must also be known. All walls and ceilings must be judged by these criteria and the contract conditions. Thus it is important that drawings and specifications be complete, accurate and easily understood.

The job inspection phase of supervision is most important and, in many cases, will determine the success of the job. An accurate check should be made of the following major categories so that best results can be obtained.

schedule of inspection

Make job inspections at the following stages:

1. When job is almost ready for materials delivery, in order to check environmental conditions and plan for delivery.

2. When materials are delivered to the job.

3. When framing is erected but before board or lath application.

4. When gypsum board base layer and/or face layer are applied.

5. When joints are treated; when veneer finish or conventional plaster is applied.

6. When job is completed.

delivery and storage

When materials are delivered, check the following:

1. See that materials meet specifications and are in good condition.

2. Store gypsum boards flat, on the floor; store plasters and bagged goods flat, on a raised platform. Protect from moisture and damage by abuse.

3. Protect framing materials from damage and moisture.

framing inspection

Framing members, either wood or metal, must meet architect's specifications and be free of defects. During and after framing construction, the following inspection should be made:

1. See that wood and steel framing materials meet specifications as required by local building codes, regulations and standards (American Softwood Lumber Standard).

2. Check accuracy of alignment and position of framing, including bracing if required, according to plans and details. Make sure load-bearing studs are directly underneath the members they are supporting.

3. See that partitions are straight and true; ceilings level.

4. Measure spacing of studs and joists. Spacing should not exceed maximum allowable for the system.

5. Look for protrusions of blocking, bridging, or piping, and twisted studs and joists that would create an uneven surface. Correct situation before board attachment.

6. Make sure there are appropriate blocking and support for fixtures and boards.

7. See that window and door frames, electrical and plumbing fixtures are set for the board thickness used.

8. Check for proper position and attachment of resilient and furring channels.

9. Review all wood and steel framing for compliance with minimum framing requirements outlined in Chapter 2.

10. Examine steel studs at corners, intersections, terminals, shelf-walls, door and borrowed light frames for positive attachment to floor and ceiling runners. All load-bearing and curtain wall studs must be attached to runner each side, top and bottom. All load-bearing studs should sit tight against web of runner.

11. Inspect spliced steel components for proper assembly. (Shaft wall and curtain wall studs, and load bearing framing should not be spliced.)

12. See that steel stud flanges all face the same direction.

13. See that preset door frames are independently fastened to floor slab and that borrowed light frames are securely attached to stud and runner rough framing at all anchor clips.

14. Make sure that door and borrowed light frames will be spot-grouted, as required.

suspended grillage

1. Measure spacing of hangers, channels and studs to see that they are within allowable limits.

2. Check ends of main runner and furring channels. They should not be let into or supported by abutting walls, and should extend to within 6″ of the wall to support a furring channel.

3. Make sure furring channel clips are alternated and that furring channel splices are properly made.

4. See that mechanical equipment is independently supported and does not depend upon the grillage for support.

5. Inspect construction around light fixtures and openings to see that recommended reinforced channel support is provided.

drywall and veneer installation

Base Layer

1. Verify that material being used complies with specifications and requirements of fire or sound rating.

2. Make sure that proper perpendicular or parallel application of board is being used, and that end joints are staggered.

3. Check for cracked and damaged-edge panels, and see that they are not used.

4. See that the recommended fasteners are being used and spaced properly.

5. Check for proper use of acoustical sealant.

6. Inspect installation to make sure thermal insulating or sound attenuation blankets are properly attached and fitted.

7. Be certain vapor retarder is installed as required.

8. Review appropriate system construction and application, and inspect for compliance with laminating recommendations and other construction procedures. On fire-rated assemblies, be sure that a DURABOND Joint Compound or USG Ready-Mixed Joint Compound-All Purpose or Taping is used for lamination.

9. See that required control joints are properly located and installed.

Face Layer

1. Verify material compliance.

2. Look for high-quality workmanship. Cracked or damaged-edge boards should not be used. Board surfaces should be free of defects; joints correctly butted and staggered.

3. Check for proper application method—perpendicular or parallel.

4. Examine fasteners for compliance with specifications, proper spacing and application.

5. Review adhesive application method and see that recommendations and specifications are being followed. Under adverse drying conditions resulting from high humidity, at either high or low temperature, drying of the laminating compound could be prolonged. Consult the Drying Time Table, page 142, for guidance.

6. Inspect trim, corner beads and related components for alignment, grounds, secure attachment and proper installation.

7. Make sure that acoustical sealant is applied around electrical outlets and other penetrations and completely seals the void.

Fasteners

1. Make sure recommended or specified fasteners are used.

2. See that fasteners are applied starting in center of board and working to ends and edges.

3. Observe whether board is held tightly against framing. Test for loose board by pushing adjacent to the fastener. See that face paper is not broken when fastener is driven. If necessary, a second fastener should be driven within 1½″ of the faulty one.

4. Examine fastener positions. Fasteners should be at least ⅜″ in from edges and ends.

5. Make sure that fastener heads in veneer assemblies are flush with the gypsum base surface, not dimpled.

Adhesives

1. See that adhesive is applied to clean, dry surfaces only.

2. Make sure that board is erected within allowable time limit after adhesive is applied so proper bond can be obtained.

3. Measure size of bead and spacing, and see that a sufficient quantity is applied.

4. Observe impacting blows for proper spacing and positioning.

5. Make sure temporary fastening and shoring holds panel tightly in place.

6. Review appropriate adhesive application methods (Chapter 2) and inspect for compliance.

Joint Treatment—Drywall

1. Make sure panel surface is ready for joint treatment. Fastener heads should be properly seated below panel surface. Protrusions should be sanded below level of surface. Joints between panels should be filled with joint compound before taping.

2. See that recommended mixing directions are followed (see Chapter 2). Only clean water and mixing equipment should be used. DURABOND Joint Compounds cannot be held over or retempered.

3. Inspect joints and corners to see that tape is properly embedded and covered promptly with a thin coat of joint compound. Only compounds suitable for embedding should be used. Heavy fills should be avoided.

4. Make sure that compound is used at its heaviest workable consistency and not overthinned with water.

5. Check to see that joint compound is allowed to dry thoroughly between coats (see Drying Time Guide, Chapter 2). *Exception:* DURABOND Joint Compounds need only have hardened prior to a subsequent application.

6. Inspect second and third coats over joints for smoothness and proper edge feathering.

7. See that fastener heads and metal trim are completely covered.

8. Smooth if necessary. Make sure that all finished joints are smooth, dry, dust free and sealed before decoration.

Joint Treatment and Finish—Veneer

1. See that corner bead is properly attached and aligned at all outside corners.

2. See that control joints are properly installed where required.

3. See that proper joint reinforcement is used—IMPERIAL Tape for normal conditions. For abnormal job or weather conditions, PERF-A-TAPE Reinforcement plus DURABOND Joint Compound.

4. See that IMPERIAL Tape is *not* overlapped at intersections.

5. Be sure that all taped, preset IMPERIAL Base joints are set before finish application begins.

6. Be sure that no gypsum base with faded face paper is installed.

conventional plaster installation

Plaster Base

1. See that material being used complies with specifications and fire or sound-tested construction.

2. Review appropriate system construction and application, and inspect for proper installation practices.

3. Check for proper application of base perpendicular to framing members, and see that end joints are staggered.

4. Check for cracked and damaged edges of plaster base. These should not be used.

5. See that the recommended fasteners or clips are being used and spaced properly.

6. Check for proper use of acoustical sealant.

7. Inspect installation to make sure that insulating blankets are properly attached and fitted.

8. Be sure that adequate supports are in place for fixture and cabinet application.

Grounds for Plastering

The thickness of basecoat plaster is one of the most important elements of a good plaster job. To insure proper thickness of plaster, grounds should be properly set and followed. The following points should be checked:

1. All openings should have specified plaster grounds applied as directed.

2. If plaster screeds are used, the dots or continuous strips of plaster must be applied to the ground thickness to permit proper plumbing and leveling.

3. Grounds should be set for recommended min. thickness for particular plaster base being used (see Chapter 5).

4. Control joints installed as required for materials and construction with lath separated behind joint.

Job Conditions for Plastering

This phase of inspection is also important. An accurate check of the following points should be made periodically:

1. At no time should plastering be permitted without proper heating and ventilation. Circulation of air is necessary to carry off excess moisture in the plaster, and a uniform temperature in a comfortable working range helps to avoid structural movement due to temperature differential.

2. To prevent "dryouts," precautions must be taken against rapid drying before plaster set has occurred. Check temperature during damp, cold weather where artificial heat is provided. During hot, dry summer weather, cover window and door openings to prevent rapid drying due to uneven air circulation.

Plaster Application

After determining what materials are to be used on the job, refer to correct mixing and application procedures described in Chapter 5.

The visible success of the job is at stake with the finish plaster coat, and required measures should be taken to finish correctly:

1. Check plaster type and mixing operation.

2. See that proper plaster thickness is maintained.

3. Inspect plaster surfaces during drying. Setting of basecoat plaster is indicated by hardening of plaster and darkening of surface as set takes place. Plaster that has set but not yet thoroughly dried will be darker in color than the unset portion, which accounts for the mottled effect as the plaster sets.

4. Consult architect's specifications to see that proper surface finish method is being used.

5. Check temperature of building for proper finish plaster drying conditions.

Cleanup

For a complete job, cleanup is the final stage. All scaffolding, empty containers and excess materials should be removed from the job site. Floors should be swept and the building and site left in good condition for decoration and finishing.

problems: their cause, remedy and prevention

The first part of this chapter deals with problems associated with gypsum construction, many of which are beyond the control of contractors working from construction documents.

Other problems, resulting from improper job conditions and application practices, are the direct responsibility of the contractor and can be controlled by him. These are discussed fully in the following section, together with corrective action to remedy the problem and prevent future recurrence.

Drywall Construction

Almost invariably, unsatisfactory results show up first in the areas over joints or fastener heads. Improper application of either the board or joint treatment *may* be at fault, but other conditions existing on the job can be equally responsible for reducing the quality of the finished gypsum board surface.

To help determine the exact problem cause, the physical appearance of each defect is described here along with a discussion of the factors causing unsatisfactory results. The checklist following contains possible causes for the irregularity and serves as an index to the numerically listed problems, causes, remedies and preventions. By checking each numerical item listed for the defect, the exact problem cause can be determined and appropriate corrective action taken.

description of defect

Fastener Imperfections—A common defect which takes on many forms. May appear as darkening, localized cracking or a depression over fastener heads, pop or protrusion of the fastener or the surface area immediately surrounding the fastener. Usually caused by improper framing or application of fasteners.

Joint Defects—Generally occur in a straight-line pattern and appear as ridges, depressions or blisters at the joints, or

darkening over the joints or in adjacent panel areas. Imperfections may be result of incorrect framing or joint treatment, or climatic conditions if remedial action has not been taken.

Loose Panels—Board does not have tight contact with framing, rattles when impacted or moves when pressure is applied to the surface. Caused by improper application of panels, framing out of alignment or improper fastening.

Joint Cracking—Appears either directly over the long edge or butt ends of boards, or may appear along the edge of taped joints. Often caused by structural movement and/or hygrometric and thermal expansion and contraction, or by excessively fast drying of joint compounds.

Field Cracking—Usually appears as diagonal crack originating from a corner of a partition or intersection with structural elements. Also seen directly over a structural element in center of a partition. May originate from corners of doors, light fixtures and other weak areas in the surface created by penetration. Caused by structural movement described earlier in this chapter. Also see Perimeter Isolation and Framing—Door and Window in Chapter 2 for use of control joints to minimize cracking.

Angle Cracking—Appears directly in the apex of wall-ceiling or interior angles where partitions intersect. Also can appear as cracking at edge of paper reinforcing tape near surface intersections. Can be caused by structural movement or improper application of joint compound in corner angle.

Bead Cracking—Shows up along edge of flange. Caused by improper bead attachment, faulty bead or joint compound application.

Wavy Surfaces—Boards are not flat but have a bowed or undulating surface. Caused by improper board fit, misaligned framing, hygrometric or thermal expansion. Also refer to Chapter 2, Handling and Storage, for proper procedure to keep boards flat before installation.

Board Sag—Occurs in ceilings, usually under high-humidity conditions. Caused by insufficient framing support for board, board too thin for span, poor job conditions, improperly installed or mislocated vapor retarder, or improperly fitted panels. Refer to Chapter 2 for proper job ventilation, storage and frame spacing—particularly with water-based texture finishes.

Surface Defects—Fractured, damaged or crushed boards after application may be caused by abuse or lumber shrinkage. Also see Discoloration below.

Discoloration—Board surface has slight difference in color over joints, supports or fasteners. Caused by improper paint finishing, uneven soiling and darkening from aging or ultraviolet light.

Water Damage—Stains, paper bond failure, softness in board core or mildew growth are caused by sustained high humidity, standing water and improper protection from water leakage during transit and storage. Refer to Chapter 2 for proper handling, storage and environmental conditions.

checklist for drywall problems

To find the specific cause for a problem described above, check, on the following pages, all numerical references listed in the particular category.

fastener imperfections	3, 4, 5, 8, 9, 10, 11, 12, 22, 23, 24, 27
joint defects	1, 4, 6, 7, 14, 18, 19, 20, 21, 24, 25, 26, 27
loose panels	3, 4, 5, 7, 8, 9, 10, 11, 12, 22, 23
joint cracking	4, 7, 15, 16, 17, 21
field cracking	13
angle cracking	15, 17
bead cracking	15
wavy surfaces	3, 7, 16
board sag	7, 10, 28
surface defects	2, 13, 25, 26, 27
discoloration	24, 25, 26, 27
water damage	2

1. PANELS—Damaged Edges

Cause: Paper-bound edges have been damaged or abused; may result in ply separation along edge or in loosening of paper from gypsum core, or may fracture or powder the core itself. Damaged edges are more susceptible to ridging after joint treatment.

Remedy: Cut back any severely damaged edges to sound board before application.

Prevention: Avoid using board with damaged edges that may easily be compressed, or can swell upon contact with moisture. Handle gypsum panels with reasonable care.

Fig. 1

2. PANELS—Water-Damaged

Cause: During transit or storage, water has damaged panels; subject to scuffing, may develop paper bond failure. Dissolved glue from bundling tapes may damage board faces and cause them to stick together. If stored wet, may be subject to mildew. Prolonged soaking or exposure to water can soften core.

Remedy: Dry wet board completely before using; handle board cautiously and re-pile with bundles separated by spacer strips of gypsum board. Check incoming board for water stains or dampness; protect carefully during shipment and storage. Do not erect damp panels, for this may result in paper bond failure. Replace boards having soft cores.

3. FRAMING—Members Out of Alignment

Cause: Due to misaligned top plate and stud, hammering at points "X" (Fig. 2) as panels are applied on both sides of partition will probably result in nailheads puncturing paper or cracking board. Framing members more than ¼″ out of alignment with adjacent members make it difficult to bring panels into firm contact with all nailing surfaces.

Remedy: Remove or drive in problem fasteners and only drive new fasteners into members in solid contact with board.

Prevention: Check alignment of studs, joists, headers, blocking and plates before applying panels, and correct before proceeding. Straighten badly bowed or crowned members. Shim out flush with adjoining surfaces. Use adhesive attachment.

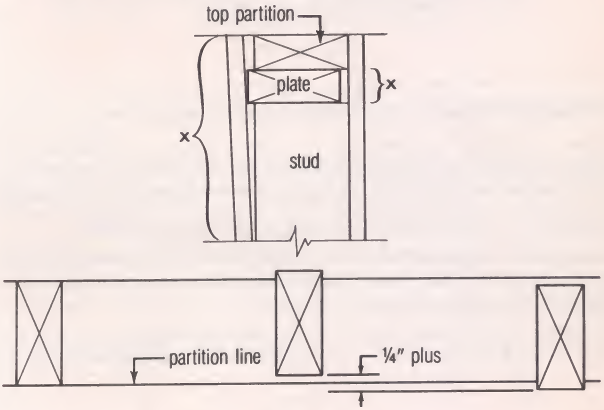


Fig. 2

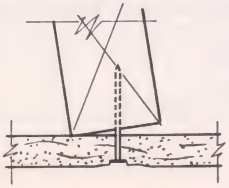
4. FRAMING—Members Twisted

Cause: Framing members have not been properly squared with plates, presenting angular nailing surface (Fig. 3). When panels are applied, there is danger of puncturing paper with fastener heads or of reverse twisting of member as it dries out, with consequent loosening of board and probable fastener pops. Warped or wet dimension lumber may contribute to deformity.

Remedy: After moisture content in framing has stabilized, remove problem fasteners and re-fasten with carefully driven USG Type W Screws.

Prevention: Align all twisted framing members before board application. Also see Framing Requirements, Chapter 2.

Fig. 3



5. FRAMING—Protrusions

Cause: Bridging, headers, firestops or mechanical lines have been installed improperly so as to project beyond face of framing, preventing panels from contacting nailing surface (Fig. 4). Result will be loose board, and fasteners driven in area of protrusion will probably puncture face paper.

Remedy and Prevention: Same as for FRAMING—Members Twisted, above.

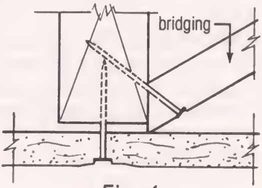


Fig. 4

6. FRAMING (Steel)—Panel Edges Out of Alignment

Cause: Improper placement of steel studs or advancing in wrong direction of panel installation can cause misalignment of panel edges and give the appearance of ridging when finished.

Remedy: Fill and feather out joint with joint treatment.

Prevention: Install steel studs with all flanges pointed in the same direction. Then install panels by advancing in the direction opposite the flange direction (Fig. 5).

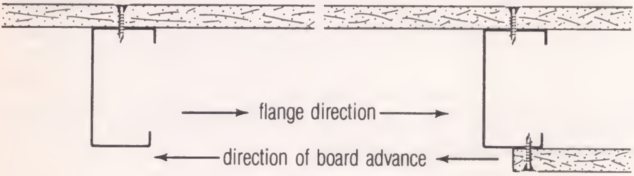


Fig. 5

7. PANELS—Improperly Fitted

Cause: Forcibly wedging an oversize panel into place bows the panel and builds in stresses preventing it from contacting the framing (Fig. 6). Result: following fastening, a high percentage of fasteners on the central studs probably will puncture the paper. May also cause joint deformation.

Remedy: Remove panel, cut to fit properly, and replace. Fasten from center of panel toward ends and edges. Apply pressure to hold panel tightly against framing while driving fasteners.

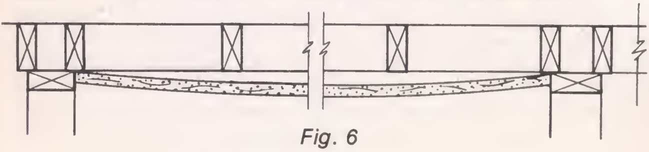


Fig. 6

8. FASTENERS—Puncturing of Face Paper

Cause: Poorly formed nailheads, careless nailing, excessively dry face paper or soft core. Nailheads which puncture paper and shatter core of panel (Fig. 7) have very little grip on board.

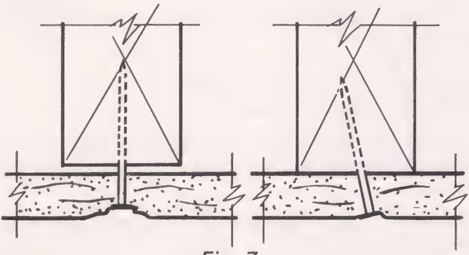


Fig. 7

Remedy: Remove improperly driven fastener and properly drive new fastener.

Prevention: Correction of faulty framing (see Framing Problems, above) and properly driven nails produce tight attachment with slight uniform dimple (Fig. 8). Nailhead bears on paper and holds panel securely against framing member. Use proper fastener or adhesive application. USG Screws with specially contoured head are best fastener known to eliminate cutting and fracturing. If face paper becomes dry and brittle, its low moisture content may aggravate nail cutting. Raise moisture content of board and humidity in work area.

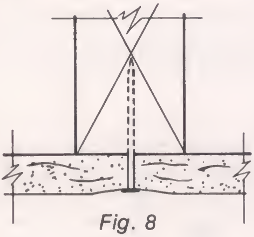


Fig. 8

9. FASTENERS—Nails Loosened by Pounding

Cause: Applying panels to the second side of a partition can loosen nails on opposite side. This is particularly true when lightweight, soft lumber, undersized studs or furring are used.

Remedy: Check panels for tightness on the partition side where panels were first applied. If looseness is detected, strike each nailhead an additional hammer blow, being careful to not overdrive the nail.

Prevention: Use proper framing, USG Type W Screws or adhesive application.

10. FASTENERS—Unseated Nails

Cause: Flexible or extremely hard framing or furring does not permit nails to be properly driven. May result from undersized framing members, type of wood used or supports which exceed the maximum allowable frame spacing.

Remedy: Replace nails with 1¼″ USG Type W Screws.

Prevention: Use proper framing (Chapter 2), Type W Screws or adhesive application.

---

11. FASTENERS—Loose Screws

Cause: Using the wrong type screw for the application or an improperly adjusted screwgun results in a screw stripping or not seating properly.

Remedy: Remove faulty fastener and replace with a properly driven screw.

Prevention: Use USG Screws with combination high/low threads for greater resistance to stripping and pullout; set screwgun clutch to proper depth.

---

12. PANELS—Loosely Fastened

Cause: Framing members are uneven because of misalignment or warping; lack of hand pressure on panel during fastening. Head of fastener alone cannot pull panel into firm contact with uneven members. Also see PANELS—Improperly Fitted.

Remedy: With nail attachment, during final blows of hammer apply additional pressure with hand to panel adjacent to nail (Fig. 9) to bring panel into contact with framing.

Prevention: Correct framing imperfections before applying panels; for a more solid attachment, use 1¼″ USG Type W Screws or use adhesive method (see Chapter 2).

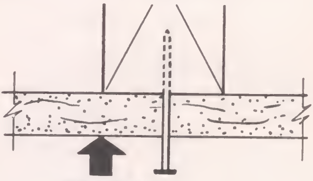


Fig. 9

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13. PANELS—Surface Fractured After Application

a. *Cause:* Heavy blows or other abuse have fractured finished wall surface—too large a break for repair with joint compound.

Remedy: Cut a square-shaped or triangular section around damaged area, with a utility or keyhole saw (Fig. 10); use a rasp or sanding block to slope edges inward at 45°. Cut corresponding plug from sound gypsum panel, sand edges to exact fit (Fig. 11). If necessary, cement extra slat of gypsum panel to back of

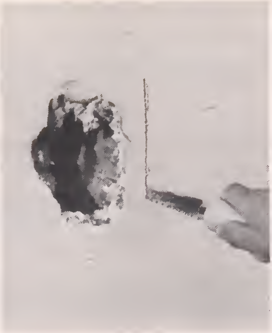

Fig. 10

Fig. 11

Fig. 12

Fig. 13

face layer to serve as brace. Butter edges (Fig. 12) and finish as a butt joint with joint compound (Fig. 13).

b. *Cause:* Attaching panel directly to flat grain of wide-dimensional wood framing members such as floor joists and headers. Shrinkage of wood causes fracture of board.

Remedy: As above, where appropriate, or repair as for joint ridging.

Prevention: To provide a flexible base to allow for movement of framing, attach RC–1 Resilient Channel to framing members and apply panels. Allow ½″ space at bottom edges of board for movement. Or attach board directly to studs but allow ¼″ separation between panels, and install USG Control Joint No. 093 (see Chapter 2—Single-Layer Application).

c. *Cause:* Knife scoring beyond corner of cutout for electrical boxes, light fixtures and door and window openings produces cracks in panel surface.

Remedy: Repair cuts with joint compound and tape before finishing.

Prevention: Stop score marks at corners, cut openings accurately.

d. *Cause:* Abnormal stress buildup resulting from structural deflection or racking discussed earlier in this chapter.

Remedy: Relieve stress, provide adequate isolation and retape, feathering joint compound over board area to disguise buildup.

Prevention: Provide proper isolation from structure to prevent stress buildup.

e. *Cause:* Excessive stresses resulting from hygrometric and/or thermal expansion and contraction discussed earlier in this chapter.

Remedy: Correct unsatisfactory environmental conditions, provide sufficient relief and retape, feathering joint compound over broad area.

Prevention: Correct improper job conditions and install control joints for relief in long partition runs and large ceiling areas (Chapter 2).

---

14. JOINTS—Blisters in Tape

Cause: Insufficient or overly thin compound was used under the tape, or tape was not initially pressed into good contact with the compound; or too much compound was forced from under tape by application of excessive tool pressure when embedding.

Remedy: Open up blistered area by slitting tape. Fill cut with joint compound and press tape back in place with knife blade. When dry smooth to level finish.

Prevention: Provide sufficient compound under entire tape.

---

15. JOINTS—Edge Cracking

a. *Cause:* After joint treatment, straight narrow cracks along edges of tape result from: too rapid drying because of high temperature accompanied by low humidity, or excessive drafts; improper application, such as overdilution of joint compound, use of wrong compound (topping instead of taping), excessive joint compound under tape or failure to follow embedding with a skim coat over tape; cold, wet application conditions which also may cause poor bond.

Because this problem is difficult to see when it first occurs, it may not be discovered until decoration begins. However, the cause can be attributed to some aspect of the taping operation.

Remedy: Especially when poor atmospheric conditions exist, carefully examine all joints after taping and skimming applications have dried; repairs are more economical at this stage. Cut away any weakly bonded tape edges. Fill hairline cracks with cut shellac (2 to 3 lb.); groove out larger cracks with sharp tool, coat with shellac and allow to dry, then refill with joint compound; or cover cracks with complete joint treatment including reinforcing tape, feather to surface level with plane of board.

Prevention: Use either USG Ready-Mixed Joint Compound or DURABOND Joint Compound which have best built-in resistance to cracks; place shielding devices over room openings to

prevent drafts; do not apply joint treatment over hot surfaces; wet down floors if room humidity is too low; during cold weather, control heat at min. 55°F (13°C) and supply good ventilation. Avoid practices listed under "Cause," above.

b. *Cause:* After joint treatment, cracks along edges of corner bead or trim can result from the same unsatisfactory conditions listed above for tape. Also can be caused by impact on the bead.

Remedy: Remove applied joint compound, securely fasten corner bead or trim to framing beneath panels, refinish bead with joint compound.

Prevention: Use USG 800 Series Corner Bead and Trim with expanded flanges which minimize cracking.

---

16. JOINTS—Center Cracking

a. *Cause:* Abnormal stress buildup resulting from structural deflection or racking discussed earlier in this chapter.

Remedy: Relieve stress, provide adequate isolation and retape, feathering joint compound over broad area to disguise buildup.

Prevention: Provide proper isolation from structure to prevent stress buildup.

b. *Cause:* Excessive stresses resulting from hygrometric and/or thermal expansion and contraction discussed earlier in this chapter.

Remedy: Correct unsatisfactory environmental conditions, provide sufficient relief and retape, feathering joint compound over broad area.

Prevention: Correct improper job conditions and install control joints for relief in long partition runs and large ceiling areas (Chapter 2).

---

17. JOINTS—Angle Cracking

a. *Cause:* Too much compound applied over tape at apex of angle.

Remedy: After compound is completely dry, smooth out excess compound at apex; fill only hairline cracks with compound. Do not apply additional compound which will build up.

Prevention: Keep excess compound from corner, leaving only a small amount or no compound in apex.

b. *Cause:* Slitting or scoring reinforcing tape during application. May result from use of improper tool.

Remedy: If crack extends through the tape, retape and finish.

Prevention: Use proper tool for corner treatment.

c. *Cause:* Structural movement from two separate supports or framing members which react independently to applied loads. Often occurs in wall-ceiling angles where wall is attached to top plate, and ceiling is attached to floor or ceiling joists running parallel to top plate.

Remedy: Remove fasteners closer than 6″ from angle, retape and finish.

Prevention: Use Floating Interior Angle application described in Chapter 2.

d. *Cause:* Structural or thermal movement resulting from two dissimilar materials or constructions.

Remedy: Remove tape, provide relief, finish with angle edge trim and caulk.

Prevention: Use channel-type or angle edge trim over gypsum board where two dissimilar surfaces interface.

---

18. JOINTS—High Crowns

Cause: Excessive piling of compound over joint; compound not feathered out beyond shoulders, improper bedding of tape; framing out of alignment or panel edges not tight against framing; improper adjustment of tools; misuse of or worn tools.

Remedy: Sand joints to flush surface (take care to avoid scuffing paper by oversanding).

Prevention: Embed tape properly, using only enough compound to cover tape and fill taper depression, or tape itself at butt joints; feather compound far enough to conceal.

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19. JOINTS—Excessive and/or Delayed Shrinkage

Cause: (1) Atmospheric conditions—slow drying and high humidity; (2) Insufficient drying time between coats of compound; (3) Excessive water added in mixing compound; (4) Heavy fills.

Remedy: See Starved Joints, below.

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20. JOINTS—Starved Joints

Cause: This is a form of delayed shrinkage caused chiefly by insufficient drying time between coats of compound. May also be caused by insufficient compound applied over tape to fill taper, overthinning or oversmoothing of compound. Shrinkage usually progresses until drying is complete.

Remedy: Use fast-hardening DURABOND 45, 90, 150, 210 or 300 Joint Compound or reapply a full cover coat of heavy-mixed compound over tape—since this is heaviest application, most shrinkage will take place in this coat, making it easier to fill taper properly. Finish by standard procedure.

Prevention: Allow each coat of joint compound to dry thoroughly before applying succeeding coat, or use a low-shrinkage DURABOND Compound.

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21. JOINTS—Ridging

Causes: All building materials grow or shrink in response to changes in temperature and humidity. When they are confined to a specific space, such as gypsum panels in a partition or

ceiling, they are put under stress, either compression or tension, depending on the temperature or humidity conditions. These stresses are relieved when the panel bends outward in the region of the joint. Once this bending takes place, the system takes a set and never returns to normal. It becomes progressively worse with each change of temperature or humidity. This progressive deformation appears as a continuous ridge along length of joint, with uniform fine, ridge-like pattern at center.

Remedy: (1) Let ridge develop fully before undertaking repairs—usually six months is sufficient. Make repairs under hot and dry conditions; (2) Smooth ridge down to reinforcing tape without cutting through tape. Fill concave areas on either side of ridge with light fill of thick-mix compound. After this is dry, float very thin film of compound over entire area; (3) Examine area with strong sidelighting to make certain that ridge has been concealed. If not, use additional feathering coats of compound. Redecorate. Ridging can recur, but if it does it is usually less severe. Continuous wetting will aggravate condition.

Prevention: Use SHEETROCK Brand SW Panels with the exclusive rounded edge designed to prevent ridging. Follow general recommendations for joint treatment (Chapter 1) and approved application procedure, which includes back-blocking and laminated double-layer application to minimize potential ridging problems (Chapter 2). Pay particular attention to temperature, ventilation, consistency of compound, prompt covering coat over tape, minimum width of fill, finish coats and required drying time between coats.

---

22. FASTENERS—Nail Pops from Lumber Shrinkage

Cause: Improper application, lumber shrinkage or a combination of both. With panels held reasonably tight against framing member and with proper-length nails, only severe shrinkage of the lumber normally will cause nail pops. But if nailed loosely, any inward pressure on panel will push nailhead through its thin covering pad of compound. Pops resulting from "nail creep" occur when shrinkage of the wood framing exposes nail shank and consequently loosens panel (see Lumber Shrinkage described earlier in this chapter).

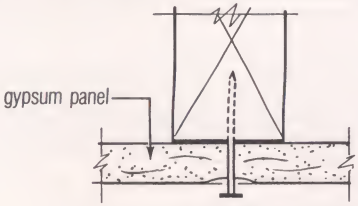

Fig. 14

Remedy: Repairs usually are necessary only for pops which protrude .005″ or more from face of board (Fig. 14). Smaller protrusions may require repair if they occur in a smooth gloss surface or flat-painted surface under extreme lighting conditions. Those which appear before or during decoration should

be repaired immediately. Pops which occur after one month's heating or more are usually caused wholly or partly by wood shrinkage, and should not be repaired until near end of heating season. An often effective procedure for resetting a popped nail is to place a 4″ broad knife over the nail and hit with hammer to seat flush with surface. A more permanent method is to drive proper nail or USG Type W Screw about 1½″ from popped nail while applying sufficient pressure adjacent to nailhead to bring panel in firm contact with framing. Strike popped nail lightly to seat it below surface of board. Remove loose compound, apply finish coats of compound and paint.

Prevention: Proper nail application; use of lumber meeting Framing Requirements (Chapter 2); attachment with USG Type W Screws or by adhesive application (Chapter 2).

---

23. FASTENERS—Bulge Around Fastener

Cause: Overdriving fasteners, driving them with the wrong tool or failing to hold board firmly against framing while driving fasteners can puncture and bulge face paper and damage core of board. Following application of joint compound or texture finish that wets the board paper can result in board bulging or swelling around fastener.

Remedy: Drive screw fastener close to damaged area, clean out damaged paper core, repair with DURABOND Joint Compound and refinish.

Prevention: Use correct tool and drive fasteners properly.
Also see Panels—Loosely Fastened.

---

24. FINISH—Discoloration

Cause: Differences in suction of panel paper and joint compound may lighten paint color or change gloss or sheen in higher-suction areas; most common when conventional oil paints are used; also caused by overthinning of paint. May also occur over fasteners in ceilings subjected to severe artificial or natural side lighting. Suction differences may also cause greater amounts of texturing material to be deposited over high-suction areas, causing color differences when viewed from an angle. Before painting, face panel paper may be darkened from exposure to sunlight.

Remedy: Redecorate. *Prevention:* Before painting or texturing, seal surface properly with a good quality white alkyd flat wall paint, latex or solvent base primer sealer. Take care to avoid roughening surface paper, when sanding joint compound.

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25. FINISH—Gloss Variation with High Gloss Paints

Cause: Differences in suction of panel paper and joint compound (as stated in no. 24, above). Problem is accentuated by strong side lighting with slight angle of incidence to ceiling or wall surface.

Remedy: Redecorate. *Prevention:* Before painting with a high

gloss paint, apply a skim coat of joint compound over the entire wall surface or use a veneer plaster system.

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26. FINISH—Joint Darkening

Cause: This condition occurs most commonly with color-tinted paint rather than white. Most severe when applied in humid weather or when joints have not fully dried; also when high or medium-alkaline joint compounds have been used.

Remedy: Apply a good quality white alkyd flat wall paint, latex or solvent base primer sealer. Repaint only after joints are thoroughly dry.

Prevention: Be sure joints are thoroughly dry before painting (see Chapter 2, Joint Compound Drying Time).

---

27. FINISH—Shadowing

Cause: Temperature differentials in outside walls or top-floor ceilings causes collection of airborne dust on colder spots of interior surface, resulting in photographing or shadowing over fasteners, furring or framing. Most severe with great indoor-outdoor temperature variation.

Remedy: Wash painted surfaces, remove spots with wallpaper cleaner, or redecorate surfaces; change air filters regularly.

Prevention: Use double-layer application with adhesively applied face layer. Use separately framed free-standing interior wall surface and insulate in void to reduce temperature difference between steel or wood components and panels.

---

28. PANELS—Board Sag

a. *Cause:* Too much weight from overlaid insulation; exposure to sustained high humidity; vapor retarder improperly installed or wetting causes ceiling panels to sag after installation. Also caused by installing board too thin for framing spacing.

Remedy: Remove sagged board or fur ceiling using RC–1 Resilient Channels and apply another layer of board.

Prevention: See Chapter 2 for proper frame spacing and application procedures.

b. *Cause:* Water-based textures wet face paper and weaken gypsum core, causing ceiling panels to sag after installation.

Remedy: Same as above. *Prevention:* See Chapter 2 for proper frame spacing and application procedures.

Veneer Construction

Many problems associated with veneer construction have the same cause, remedy and prevention as with drywall systems. The similarity appears in application of the base, framing irregularities, cracking due to structural movement, hygrometric and

thermal expansion, and fastener imperfections. The additional problems shown below are those specifically relating to veneer finish construction. If solutions to your problems in veneer construction are not shown, check similar problems for drywall construction found earlier in this chapter.

application

1. MIXING—Foaming Action in Mixer

Cause: Use of alum as an accelerator when limestone aggregate is used.

Remedy: None—dispose of batch.

Prevention: Use moulding plaster or quick-set gauging plaster as an accelerator when limestone aggregate is used. Or, use sand aggregate.

---

2. SETTING TIME—Variable Set Time Within Batch

Cause: Insufficient or excessive mixing.

Remedy: None—dispose of batch.

Prevention: Use proper drill speed; follow recommended mixing times (see Chapter 2).

---

3. SLOW SET—DIAMOND Interior Finish

Cause: Temperature below 40°F (4°C), or in excess of 100°F (38°C).

Remedy: None—dispose of batch.

Prevention: Avoid extremes of air and mix water temperatures.

---

4. QUICK SET—DIAMOND Interior Finish

a. *Cause:* Contamination; dirty mixing equipment.

Remedy: None—dispose of batch.

Prevention: Use potable water; clean set plaster residue from equipment after each batch. *Always* use clean mix equipment.

b. *Cause:* Excessive use of aggregate and/or accelerator.

Remedy: None—dispose of batch.

Prevention: Follow recommendations for mix proportions and use of additives.

---

5. QUICK SET—IMPERIAL Finish

a. *Cause:* Excessively low temperatures.

Remedy: None—dispose of batch.

Prevention: Maintain min. 55°F (13°C) air and mix water temperature.

b. *Cause:* Contamination; excessive use of aggregate and/or accelerator.

Remedy: None—dispose of batch.

Prevention: Same as for DIAMOND Interior Finish.

---

6. WORKABILITY—Stiff Working

Cause: Mixing action has improper or insufficient shear.

Remedy: None—use remainder of batch if at all workable.

Prevention: Follow recommendations for mixing time, drill speed and type of mixing paddle (see Chapter 2).

---

in-place

7. BOND FAILURE—Delamination of Finish Coat

Cause: Basecoat too smooth; finish coat not properly scratched into basecoat to have necessary keying.

Remedy: Remove loose material, brush basecoat thoroughly, apply bonding agent and refinish.

Prevention: Follow application recommendations (Chapter 2).

---

8. BOND FAILURE—DIAMOND Interior Finish

Cause: Application over faded (not normal blue color) gypsum base.

Remedy: Remove loose material, brush base clean, apply bonding agent and refinish.

Prevention: Do not store or apply base where it will be exposed to sunlight for an extended period of time. Where exposed, spray faded base with alum solution or bonding agent before finish is applied.

---

9. CRACKS—Joint Cracking

a. *Cause:* IMPERIAL Tape overlapped at joint intersections.

Remedy: Large cracks—apply PERF-A-TAPE Reinforcement and USG Ready-Mixed Joint Compound–All Purpose or Taping over the cracks. Minor cracking—flush out area with USG Ready-Mixed Joint Compound–All Purpose or Taping.

Prevention: Avoid overlapping tape at all joint intersections, including those at angles.

b. *Cause:* Improper steel stud placement; gypsum base application advanced in wrong direction relative to flange direction.

Remedy: Repair with PERF-A-TAPE Reinforcement and USG Ready-Mixed Joint Compound–All Purpose or Taping.

Prevention: Install steel studs with all flanges pointing in same direction; arrange gypsum base application so lead edge of base is attached to open edge of flange first (see No. 6 under Drywall Framing Problems.)

c. *Cause:* Overly rapid drying conditions.

Remedy: Repair with PERF-A-TAPE Reinforcement and USG Ready-Mixed Compound-All Purpose or Taping.

Prevention: Liberally sprinkle floor with water to raise humidity. Use PERF-A-TAPE Reinforcement and DURABOND Joint Compound on all joints. Allow compound to dry thoroughly before applying finish.

---

10. CRACKS—Field Cracking

Cause: Gypsum base installed with vertical joints extending from corners of door and window openings.

Remedy: Apply PERF-A-TAPE Reinforcement and DURABOND Joint Compound finished with USG Ready-Mixed Joint Compound-All Purpose or Taping, prime and seal (this is a cosmetic treatment; there is no guarantee that cracks will not reopen).

Prevention: Install USG Control Joints or cut base to fit around openings with joints centered above openings, *not* at corners.

---

11. CRACKS—Craze and Map Cracking

Cause: Veneer application too thin. Also can be caused by too rapid drying.

Remedy: Apply spackling putty, prime and seal.

Prevention: Apply recommended thicknesses for both one- and two-coat work. Avoid excessive ventilation which may cause rapid drying. When weather is hot and dry, sprinkle floor with water to raise humidity.

---

12. BLEMISHES—Blistering

a. *Cause:* Loose paper on gypsum base as a result of improper cutting or from "peelers" caused by careless handling.

Remedy: Cut and remove unbonded paper, apply bonding agent if gypsum core is exposed, and refinish.

Prevention: Follow proper handling and cutting procedures.

b. *Cause:* Troweling too early and lack of absorption; excessive material buildup.

Remedy: Minimize troweling and allow finish to become firm. Finish-trowel over freshly set surface to eliminate blisters.

Prevention: Apply material in uniform thickness with minimum amount of troweling to produce smooth surface.

---

13. BLEMISHES—Joint Ridging and Beading

Cause: Joints not preset; excessive ventilation and poor heat control. Most likely to occur with one-coat applications.

Remedy: Repair with USG Ready-Mixed Joint Compound-All Purpose or Taping.

Prevention: Preset all joints before veneer finish application;

keep ventilation to minimum and control heat. In extremely hot, dry weather use PERF-A-TAPE Reinforcement and a DURABOND Joint Compound as alternate joint reinforcement.

---

14. BLEMISHES—Spalling at Exterior Corners

Cause: Use of solid-flange drywall corner bead.

Remedy: Remove all loose material and corner bead. Install expanded-flange corner bead and refinish.

Prevention: Use expanded-flange corner bead.

---

15. STAINS—Staining and Rusting

Cause: Use of improper fasteners, or exposed, improperly prepared metal trim.

Remedy: Apply rust-locking primer over stains.

Prevention: Use recommended coated fasteners (see Chapter 1). Apply rust-locking primer to all exposed metal.

---

16. SOFT, WEAK SURFACE—Dryouts

Cause: Too rapid drying conditions.

Remedy: Fog-spray surface with water or alum solution to provide setting action. When set, apply USG Ready-Mixed Joint Compound-All Purpose or Taping for acceptably smooth surface.

Prevention: Avoid extending set and/or temperature and humidity conditions which cause rapid drying.

---

17. SOFT, WEAK SURFACE—Crumbly Areas

Cause: Use of excessive amount of sand aggregate and/or retarder.

Remedy: Treat soft areas with penetrating sealer.

Prevention: Allow minimum ventilation; use recommended amounts only of aggregate or retarder. Avoid prolonged set.

Texture Finishes

U.S.G. texturing materials offer a wide range of decorative yet practical finishes. Properly used, they can provide interest and variety in decoration while covering minor defects in the base surface. However, certain working conditions, application techniques or equipment problems can cause unsatisfactory results. The following list describes the problem, probable cause and remedy for particular situations.

---

1. MIXING—Lumping of Wet Mix

Cause: Too much water added to initial mix, making lumps difficult to break up.

Remedy and Prevention: Initial amount of water added to mix should be slightly less than recommended. After lumps are broken up, add remaining water.

---

2. MIXING—Slow Solution Time

Cause: Insufficient soaking and/or use of very cold water.

Remedy and Prevention: Allow materials to soak for up to two hours, as necessary, if using cold water.

---

3. MIXING—Wet Mix Too Thin

Cause: Addition of excessive water during initial mix. Also, insufficient soaking time in cold water.

Remedy and Prevention: Use recommended amount of water to insure proper consistency. Allow materials to soak up to two hours, if necessary, when using cold water.

---

4. APPLICATION—Excessive Aggregate Fallout in Spraying

Cause: Excessive air pressure at nozzle, or holding gun too close to surface being sprayed.

Remedy and Prevention: Use proper air pressure for type of material to be sprayed; low for IMPERIAL QT Spray Texture Finish, high for USG Spray Texture Finish. (Consult appropriate U.S.G. product data sheet for recommended air pressure.) Hold spray gun at proper distance from surface to prevent excessive bounce or fallout of aggregate.

---

5. APPLICATION—Flotation of Aggregate

Cause: Overdilution of job mix and/or lack of adequate mixing after water is added to control consistency.

Remedy and Prevention: Add correct amount of water as directed on bag to insure proper suspension of materials in mix. Make certain that water is blended into mix.

---

6. APPLICATION—Poor Coverage with Spray Finishes

Cause: Not enough water to bring texture material to proper spray viscosity and/or improper application such as moving spray gun too slowly, overloading spray surface and using incorrect spray pressures.

Remedy and Prevention: Add proper amount of water as directed on bag. Use correct spray gun pressures and application technique to insure uniform texture with maximum coverage.

---

7. APPLICATION—Poor Hide

Cause: Overdilution of mix causing reduction in hiding power. Insufficient water in spray finishes causes poor material atomi-

zation, resulting in surface show-through. Also caused by over-extending material or choosing incorrect spray pressures.

Remedy and Prevention: See above.

---

8. APPLICATION—Poor Bond or Hardness

Cause: Overdilution of job-mix results in thinning out of binder in texture. Contamination or intermixing with other than recommended materials can destroy bonding power.

Remedy and Prevention: Add proper amount of water as stated in bag directions. Always use clean mixing vessel and water. Never intermix with other products (except materials as recommended).

---

9. APPLICATION—Stoppage of Spray Equipment

Cause: Contamination of material or oversize particles can cause clogging of spray nozzle orifices. Also caused by using incorrect nozzle size for aggregate being sprayed.

Remedy and Prevention: Prevent contamination during mixing. Use correct nozzle for aggregate size of texture material.

---

10. APPLICATION—Unsatisfactory Texture Pattern

Cause: Improper spray pressures and/or worn spray equipment, either fluid or air nozzle. Also improper spraying consistency of mix and/or spraying technique.

Remedy and Prevention: Use recommended amount of water to insure proper spraying consistency. Handle spray equipment correctly to achieve best results. Make certain that spray accessories are in good working condition; replace when necessary.

---

11. APPLICATION—Unsatisfactory Pumping Properties

Cause: Mix too heavy. Pump equipment worn or of insufficient size and power to handle particular type of texture.

Remedy and Prevention: Use recommended amount of water to insure proper spraying consistency. Make sure that equipment is in good repair and capable of pumping heavy materials.

---

12. APPLICATION—Texture Buildup

Cause: Texturing over a high-suction drywall joint (surface not properly sealed) and/or allowing too much time between roller or brush application and texturing operation. Overdilution of texture material will produce texture buildup over joint.

Remedy and Prevention: Seal entire surface with a good quality white alkyd flat wall paint or vinyl or alkyd base primer sealer before texture application. Use correct amount of water when mixing texture material and allow safe time interval between application and final texturing.

---

13. APPLICATION—Poor Color Match, Ceiling and Sidewall

Cause: Overspray on ceiling when walls are sprayed with different texture material that is not matched for color.

Remedy and Prevention: Use color-matched USG Spray Texture Finish for sidewalls with IMPERIAL QT Spray Texture Finish for ceilings. (Paint added at job to either wall or ceiling texture can cause color difference.)

---

14. FINISH SURFACE—Poor Touchup

Cause: It is very difficult to touch-up a textured surface to completely blend with the surrounding texture. A conspicuous touchup is caused either by texture or color variance.

Remedy: Perform touchup operation with extreme care; otherwise, re-texture entire wall or ceiling area.

---

15. FINISH SURFACE—Joint Show-Through

Cause: Overthinned or overextended texturing material does not adequately hide the normal contrast between joint and gypsum panel paper. Also caused by improperly sealed surface.

Remedy: Use correct amount of water when mixing texture material and apply at recommended rate of coverage until joint is concealed.

Prevention: Seal entire surface with a good quality white alkyd flat wall paint latex or solvent-based primer/sealer before spray texture application.

---

16. FINISH SURFACE—White Band or Flashing Over Gypsum Panels

Cause: High-suction gypsum panel joint causes a texture variation which often appears as a color contrast.

Remedy: Allow texture to dry, and paint entire surface.

Prevention: Seal entire surface with a good quality white alkyd flat wall paint latex or solvent-based primer/sealer before spray texture application.

---

17. FINISH SURFACE—White Band or Flashing Over Concrete

Cause: Damp concrete surface on which leveling compound has dried completely can produce results similar to those of high-suction joint.

Remedy: Allow texture to dry, and paint entire surface.

Prevention: Allow concrete to age for at least 60 days for complete dryout; then seal with a good quality white alkyd flat wall paint latex or solvent-based primer/sealer before spray texture application.

18. FINISH SURFACE—Joint Darkening

Cause: Application over damp joint compound, especially in cold, humid conditions.

Remedy: Allow texture to dry completely, and paint entire surface.

Prevention: Seal surface with a good quality white alkyd flat wall paint latex or solvent-based primer/sealer before spray texture application.

Conventional Plaster Construction

All U.S.G. basecoat and finish plasters are carefully manufactured and thoroughly tested before shipment. Along with the functional characteristics provided, U.S.G. plasters are carefully formulated for use under normal, prevailing weather conditions and with aggregates commonly used in the market.

Plasters are adversely affected by aging and abnormal storage conditions, use of the wrong aggregate and improper proportioning—all of which may affect the set, hardness and working properties of the material. Most plaster problems result from the following situations:

1. Adverse atmospheric and job conditions.
2. Set conditions—too fast or slow.
3. Poor quality and incorrect proportioning of aggregate.
4. Improper mixing, application or thickness of basecoat or finish.
5. Incorrect lathing practices.
6. Dirty or worn mixing or pumping equipment.

Basecoat and finish coat plasters are so closely interrelated that problems pertaining to their use are treated together. No attempt is made here to discuss problems that might occur due to structural deficiencies. These have been covered earlier in this chapter. Plaster problems are classified under the specific type of condition which exists. These are discussed in order, in the following groups:

1. Plaster cracks.
2. Blemishes, color variation, surface stains.
3. Weak, soft walls.
4. Bond failure.
5. Set and working qualities.
6. Gauged lime putty problems.

---

1. CRACKS—Connecting vertical, horizontal cracks at somewhat regular intervals, often in "stepped" pattern, also diagonal.

Material—Plaster over metal or gypsum lath.

a. *Cause:* Plaster too thin, insufficient plaster grounds.
Remedy: Patch. *Prevention:* Apply plaster to proper thickness.

b. *Cause:* Weak plaster (through dryout or slow set).
Remedy: Spray with alum solution to accelerate set.

Prevention: Add accelerator to plaster mix to bring setting time to normal range.

c. *Cause:* Excessive use of aggregate.
Remedy: Patch. *Prevention:* Use proper proportions of aggregate and plaster.

d. *Cause:* Failure to use Striplath reinforcement at potential weak points.

Remedy: Cut out, reinforce and repair.
Prevention: Install proper reinforcing.

e. *Cause:* Expansion of rough wood frames.

Remedy: Remove plaster and lath as necessary. Seal frames and patch.

Prevention: Seal frames. Cut basecoat along grounds prior to set. Install control joints over frames.

Material—Plaster over unit masonry.

Cause: Structural movement of masonry units.

Remedy and Prevention: Correct masonry construction, install control joint, patch.

Material—Plaster over brick, clay tile or concrete block at door openings.

Cause: Poor lintel construction, improper frame construction.

Remedy: Patch. *Prevention:* Use proper frame and lintel construction with self-furring metal lath reinforcement.

---

2. CRACKS—Fine cracks, random pattern, generally 1″ to 3″ apart. Includes shrinkage cracks, crazing, alligatoring, chip cracks.

Material—Gauged lime putty finish over gypsum basecoat, used with any plaster base.

Cause: Insufficient gauging plaster—shrinkage of lime. Insufficient troweling during setting. Applied finish too thick. Basecoat too wet or too dry and too little or too much suction.

Remedy: Apply spackling putty and primer-sealer.

Prevention: Use sufficient gauging plaster, trowel sufficiently, or properly condition basecoat before applying finish.

---

3. CRACKS—Fine cracks, irregular pattern, generally 6″ to 14″ apart; "map cracking".

Material—Trowel finishes over gypsum basecoat—unit masonry plaster base.

a. *Cause:* Finish coat applied too thick.

Remedy: Patch. *Prevention:* Apply finish coat to 1/16″ thickness but not more than 1/8″.

b. *Cause:* Improper timing of final troweling.

Remedy: Patch. *Prevention:* Water-trowel as final set takes place (not before) to provide dense, smooth surface.

c. *Cause:* Retempering gauged lime putty.
Remedy: Discard batch; make up new gauge.

Prevention: Gauged lime putty should not be retempered once it has started final set.

---

4. CRACKS—Random pattern, usually less than 12″ apart, called map, shrinkage or fissure cracking.

Material—Basecoat over masonry.

a. *Cause:* High suction of masonry base.

Remedy: If bond to base is sound and cracks are open 1⁄16″ or more, fill by troweling across cracks with properly aggregated plasters. If bond is sound, finish over fine cracks with highly gauged trowel finish or float finish. If curled at edges and bond is unsound, remove and reapply using proper plaster method.

Prevention: Wet masonry with water to reduce suction before basecoat application.

b. *Cause:* Under-aggregating of basecoat; slow set.

Remedy: Same as above. *Prevention:* Use 3 cu. ft. of aggregate per 100 lb. gypsum plaster (see Chapter 4 for proper proportion of aggregates). Discontinue use of job-added retarder and accelerator, if necessary, to obtain proper set.

c. *Cause:* Dryout condition.

Remedy: Spray basecoat either with water or alum solution to thoroughly wet plaster. Proceed same as above.

Prevention: In hot, dry weather, protect plaster from drying too rapidly before set. Spray plaster during set time if necessary.

---

5. CRACKS—At wall or ceiling angles.

Material—Plaster over gypsum lath.

a. *Cause:* Thin plaster.

Remedy: Cut out and patch. *Prevention:* Follow correct application procedure.

b. *Cause:* Failure to use Cornerite reinforcement.
Remedy and Prevention: Same as above.

---

6. BLEMISH—Water-soluble, powdery crystals on surface, generally white but may be colored. Can be brushed off.

Material—Basecoat and finish plaster over concrete block or clay tile.

Cause: Efflorescence. As masonry units dry, water-soluble salts from units or mortar joints leach out and are deposited on the plaster surface.

Remedy: After plaster surfaces are thoroughly dry, brush off efflorescence, apply oil-base sealer and paint.

Prevention: On interior walls, eliminate source of moisture, remove efflorescence before plastering; decorate with oil-base sealer and paint. On exterior walls, eliminate moisture source, fur out, lath and plaster.

---

7. BLEMISH—"Pops", peak-like projections which fall out and create little craters or pits; often with fine radial cracks.

Material—Gauged lime putty finish.

a. *Cause:* Unslaked lime in mortar which slakes and swells after it is applied.

Remedy: Remove core of "pops" and patch after popping has ceased.

Prevention: Allow sufficient soaking time for normal hydrated lime, or use double-hydrated lime or a prepared finish such as RED TOP Finish Plaster.

b. *Cause:* Contamination from foreign matter.
Remedy: Same as above. *Prevention:* Eliminate source of impurity.

Material—Gypsum basecoat and finish.

Cause: Lumpy or undissolved retarder added on job. Retarder lumps swell or "pop" when wet.

Remedy: Cut out spots and patch.

Prevention: Completely disperse retarder before adding to mix water; mix well to distribute retarder throughout plaster.

---

8. BLEMISH—Blisters in finish coat occur during or immediately after application.

Material—Gauged lime putty finish.

a. *Cause:* Base too green (wet); insufficient suction; too much water used in troweling.

Remedy: After finish has set, trowel with very little water.
Prevention: Do not apply finish coat over green basecoat.

b. *Cause:* Finish too plastic.

Remedy: Same as above. *Prevention:* Add small amount of very fine white sand to putty, or increase amount of gauging plaster.

---

9. BLEMISH—Excess material ("slobbers") on finish surface.

Material—Gauged lime putty finish.

Cause: Improper joining technique, excessive or improper troweling leaves excess material on finished surface.

Remedy: Scrape off excess material before decoration. Seal surface when plaster is dry.

Prevention: Previously applied finish should be cut square for completion of finish. Avoid excessive troweling at joining.

---

10. BLEMISH—Peeling paint.

Material—Gauged lime putty finish.

a. *Cause:* Paint applied over wet plaster.

Remedy: Scrape off peeled paint, allow plaster to dry, and redecorate.

Prevention: Be sure plaster is dry before decorating, and use a breather-type paint.

b. *Cause:* Weak finish. Plaster worked through set.
Remedy: Scrape off peeled paint, patch and decorate.
Prevention: Do not retemper or trowel finish after set.

---

11. COLOR VARIATIONS—Streaks and discoloration.

Material: Lime finishes, gauged with gauging plaster or Keenes Cement.

a. *Cause:* Lime and gauging plaster not thoroughly mixed.
Remedy: Seal and decorate. *Prevention:* Follow recommended mixing procedures.

b. *Cause:* Too much water used in troweling.
Remedy: Same as above. *Prevention:* Apply as little water as possible in troweling.

c. *Cause:* Dirty tools or water.
Remedy: Same as above. *Prevention:* Wash tools and use clean water.

---

12. COLOR VARIATIONS—Light and dark spots.

Material—Float finish.

a. *Cause:* Improper technique or too much water used in floating.

Remedy: Seal and paint to get uniform color.
Prevention: Follow recommended application procedures.

b. *Cause:* Spotty suction on basecoat which was dampened unevenly by throwing water on with a brush rather than by spraying with a fine nozzle.

Remedy: Same as above. *Prevention:* Dampen basecoat uniformly using a fine spray.

---

13. COLOR VARIATIONS—Light or flat spots in light-color paint.

Material—Oil paint over gauged lime putty finish.

Cause: Surface painted too soon after plastering (alkali in lime saponifies paint); paint pigments not limeproof.

Remedy and Prevention: Apply primer-sealer and repaint.

Material—Any colored paint over any plaster finish.

Cause: Non-uniform absorption results in uneven surface gloss and coloration.

Remedy and Prevention: Apply primer-sealer and repaint.

---

14. SURFACE STAINS: Yellow, brown or pink staining—"yellowing".

Material—Any lime putty finish over any basecoat and plaster base; generally occurs while surface is damp.

a. *Cause:* Contaminated aggregate.
Remedy: Apply primer-sealer and repaint.
Prevention: Use clean aggregate.

b. *Cause:* Smoke fumes from gas heater.
Remedy: Same as above. *Prevention:* Vent heaters to outside.

c. *Cause:* Tarpaper behind plaster base; creosote-treated framing lumber; tar or tar derivatives used around job; sulphur or chemical fumes.

Remedy: Same as above. *Prevention:* Use asphalted paper. Remove source of air contamination.

---

15. SURFACE STAINS—Rust.

Material—Plaster over any plaster base.

Cause: Rusty accessories; or any protruding metal.
Remedy: Apply rust-locking primer-sealer and decorate.

Prevention: Use accessories made of zinc alloy or with hot-dip galvanizing. *Do not* use accessories that show rust prior to installation.

---

16. SOFT WALLS—Soft, white, chalky surfaces, occurring during hot, dry weather, usually near an opening.

Material—Gypsum basecoat over any plaster base.

Cause: Dryout. Too much water has been removed before plaster can set.

Remedy: Spray with alum solution or plain water to set up dryout areas.

Prevention: Screen openings in hot, dry weather; spray plaster during set; raise humidity by sprinkling floor with water.

---

17. SOFT WALLS—Soft, dark, damp surfaces occurring during damp weather.

Material—Gypsum basecoat over any plaster base.

Cause: Sweat-out. Too little ventilation allowed water to remain in wall for an extended period after plaster set. Some plaster has re-dissolved.

Remedy: Dry walls with heat and ventilation. If sweat-out condition continues, there is no remedy; remove and replaster.

Prevention: Properly heat and ventilate during plastering.

---

18. SOFT WALLS—Soft, dark, damp surfaces, occurring in freezing weather.

Material—Gypsum basecoat over any plaster base.

Cause: Frozen plaster.

Remedy: If plaster freezes before set, no remedy except to remove and replaster.

Prevention: Close building, supply heat.

---

19. SOFT, WEAK WALLS—General condition, not spotty or due to slow set.

Material—Gypsum basecoat over any plaster base.

Cause: Too much aggregate or fine, poorly graded aggregate.
Remedy: No remedy; remove and replaster.
Prevention: Use properly graded aggregate and correct proportioning.

---

20. WEAK WALLS—Weak plaster.

Material—Gypsum basecoat.

Cause: Extremely slow set.
Remedy: Spray with alum solution to accelerate set.

Prevention: Add accelerator to plaster mix to bring setting time within normal range.

Material—Gauged lime putty finish over any basecoat.

Cause: Too little gauging with insufficient troweling, retempering, basecoat too wet.

Remedy: No remedy; remove and replaster.

Prevention: Use proper ratio of gauging to lime putty. Do not retemper plaster. Trowel adequately to assure desired hardness.

---

21. BOND FAILURE—Basecoat separation.

Material—Gypsum basecoat over gypsum or metal lath.

Cause: Too much aggregate, plaster application over frost on lath, freezing of plaster before set, or addition of lime or portland cement. Excessive delay in plaster application after mixing, extremely slow set or retempering.

Remedy: No remedy except to replaster.

Prevention: Provide proper job conditions during plastering. Follow correct mixing and application procedures.

---

22. BOND FAILURE—Brown coat separation from scratch coat.

Material—Gypsum basecoat plasters.

a. *Cause:* Weak scratch coat.
Remedy: None; remove and replaster.
Prevention: Use proper aggregate amount. Avoid retempering.

b. *Cause:* Failure to provide mechanical key in scratch coat.

Remedy: Roughen scratch coat and replaster.
Prevention: Cross-rake scratch coat to provide rough surface for brown coat.

a. *Cause:* Dryout of scratch coat.

Remedy: Water-spray scratch coat for thorough set before brown coat application.

Prevention: Provide proper job conditions during plastering; screen openings in hot, dry weather. Water-spray plaster during set. Raise humidity by sprinkling floor with water.

---

23. BOND FAILURE—Finish coat separation.

Material—Gauged lime putty finish applied over gypsum brown coat.

a. *Cause:* Brown coat too smooth, too dry, wet or weak; finish improperly applied.

Remedy and Prevention: Strip off finish, correct condition of brown coat and replaster.

b. *Cause:* Frozen finish coat.

Remedy and Prevention: Remove finish, provide sufficient heat during plastering, reapply finish.

c. *Cause:* Incomplete hydration of finish lime.

Remedy and Prevention: Remove finish; using properly proportioned double-hydrated lime or a prepared finish, reapply finish.

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24. SLOW SET—See Soft, Weak Walls.

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25. QUICK SET—Plaster sets before it can be properly applied and worked.

Material—Gypsum basecoat over any plaster base.

a. *Cause:* Dirty water, tools or mixing equipment, or excessive use of accelerator.

Remedy: Discard material as soon as it begins to stiffen; do not retemper. *Prevention:* Use clean water, tools and equipment.

b. *Cause:* Mixing too long.
Remedy: See above. *Prevention:* Reduce mixing time.

c. *Cause:* Poor aggregate.

Remedy: See above. *Prevention:* Use clean, properly graded aggregate or add retarder.

d. *Cause:* Error in manufacture.

Remedy: See above. Send samples to manufacturer's representative. *Prevention:* Add retarder.

e. *Cause:* Machine-pumping and application that exceed limits of time and distance pumped for plaster being used.

Remedy: See above. *Prevention:* Add retarder. Use plaster designed for machine application.

---

26. ERRATIC SET—Lack of uniformity in set.

Material—Gauged lime putty over gypsum basecoat.

Cause: Variable temperature.

Remedy and Prevention: Maintain uniform job temperature. In cold weather, heat building to min. 55°F (13°C).

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27. POOR WORKING—Works hard or "short", loses plasticity and spreadability. Does not carry proper amount of aggregate.

Material—Gypsum basecoat over any plaster base.

a. *Cause:* Aged or badly stored plaster.

Remedy: Obtain fresh plaster and mix equal parts with aged plaster, or use less aggregate. *Prevention:* Use fresh plaster.

b. *Cause:* Over-aggregating.
Remedy: None. *Prevention:* Use proper proportioning.

Material—Gauged lime putty over gypsum basecoat.

a. *Cause:* Aged lime, partially carbonated; warehoused too long or improperly.

Remedy: None. *Prevention:* Use fresh material.

b. *Cause:* Improper soaking, slaking. Low temperature during putty preparation.

Remedy: None. *Prevention:* Use proper lime putty preparation procedure. Do not soak at temperatures below 40°F (4°C).

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28. SOUPY LIME—Material too fluid for proper gauging and application.

Material—Lime putty.

a. *Cause:* Soaked too wet.
Prevention: Follow directions for type of lime being used.

b. *Cause:* Cold weather, cold mixing water.

Prevention: The gelling action of lime is retarded when material is soaked in temperatures less than 40°F (4°C) with cold water. Use warm water to quicken gelling.

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29. LUMPY LIME—Material too lumpy for proper blending with gauging plaster.

Material—Lime putty.

a. *Cause:* Old lime. *Prevention:* Use fresh lime.

b. *Cause:* Damp lime.
Prevention: Protect lime from moisture on job and in storage.

c. *Cause:* Incorrect soaking.
Prevention: Follow soaking directions for type of lime used.

d. *Cause:* Excessive evaporation.
Prevention: Cover lime box with tarpaulin to reduce evaporation.

chapter 8

common problems–equipment–appendix and glossary

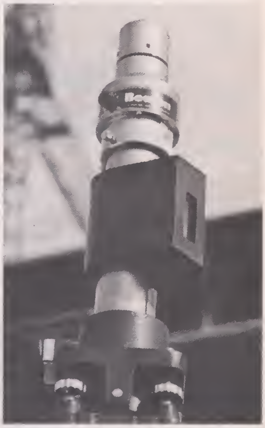
tools and equipment

The Tools You Need

Suitably designed tools are essential for high-quality workmanship. Using the right tools for specific jobs can improve efficiency and reduce labor costs. This chapter contains an extensive sampling of tools designed to meet needs of drywall, veneer and plastering contractors. Some of the more commonly used hand tools can be found at building material dealers and hardware stores.

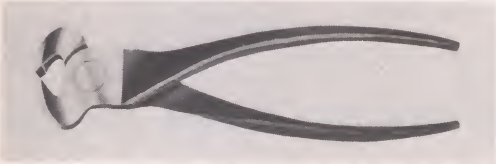
Framing Tools

Laser Alignment Tool—An extremely precise "sighting" device that utilizes a laser beam for all construction alignment jobs. Provides maximum accuracy and speed for partition layouts and leveling of suspended ceiling grillage.

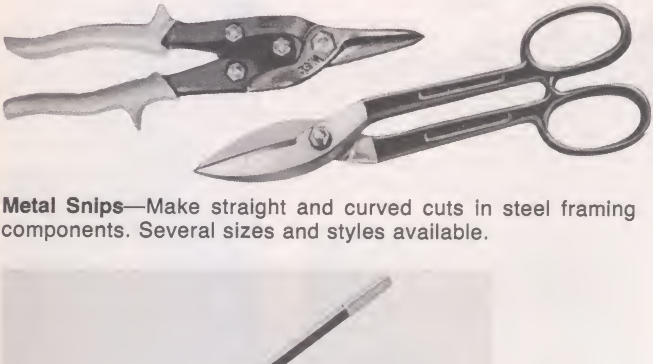


Stud Driver—Used to drive fasteners in concrete for attachment of runner track. Power-driven model shown. Also available in hammer-driven models.

Magnetic Hammer—Magnetic head holds nails to speed attachment of floor and ceiling runners. Replaceable stainless steel magnet.



End Cut Nippers—Lather's nippers for wire-tied attachments of metal lath, grillage and framing components.



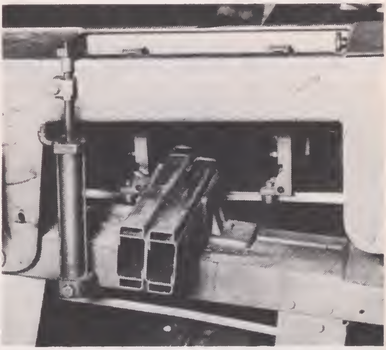
Metal Snips—Make straight and curved cuts in steel framing components. Several sizes and styles available.

Channel Stud Shear—Cuts steel studs and runners quickly, cleanly without deforming. Has fixed guides for 1⅝", 2½" and 3⅝" sizes. For use with a maximum steel thickness of 20 ga.

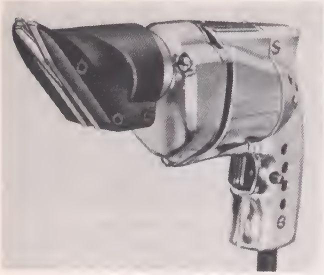
Circular Saw—Cuts steel studs, runners and joists of various gauges with appropriate blade. Hand-held and portable, it assures easy on-site cutting and trimming.

Chop Saw—The chop saw's abrasive wheel cuts all framing members. Its steel base can be placed on a bench, saw horse or floor for fast and efficient gang-cutting of members.

Cut-off Saw—Hand-held, this saw uses an abrasive wheel and provides more power than a circular saw. For on-site work with heavier-gauge members.



Band Saw—A variety of models are available for use in cutting steel framing members—both bench and floor models with wet or dry systems. Variable blade speeds and vertical cutting options provide on-site flexibility.



Electric Shear—Cuts steel studs, runners, sheet metal and cold-rolled steel up to 20 ga. Replaceable steel blades. Cutting head rotates 180° for side and overhead work.

USG Metal Lock Fastener—For rigid attachment of standard steel studs to steel runners, and metal trim to steel studs. Pierces and folds over light-gauge metal to form a positive, permanent lock. Leaves no protrusions to interfere with tight, flush gypsum panel attachment. Available from United States Gypsum.

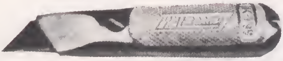
Combination Chalk Line Box and Plumb Bob—A plumb-bob shaped device that holds retractable 100-ft. chalk line and chalk. Single tool plumbs floor-ceiling alignments, snaps chalk line.

Magnetic Punch—Holds and drives nails for floor and ceiling channels in hard-to-get-at areas. Available in several sizes.

Board and Lath Application Tools

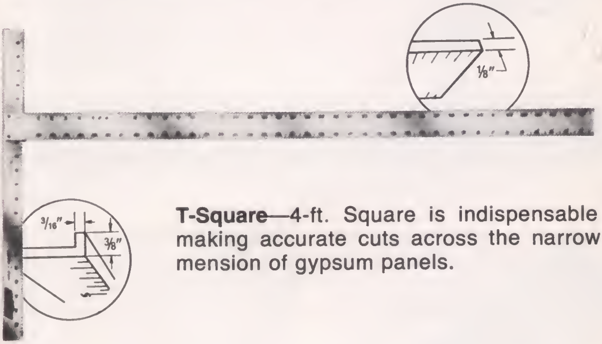
Steel Rule With Cutting Guide—The adjustable tape guide

protects fingers and provides sure grip for holding accurate measurements.

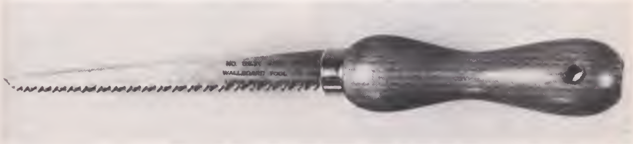


Utility Knife—The standard knife for cutting gypsum panels. Has replaceable blade; extra blades stored in handle.

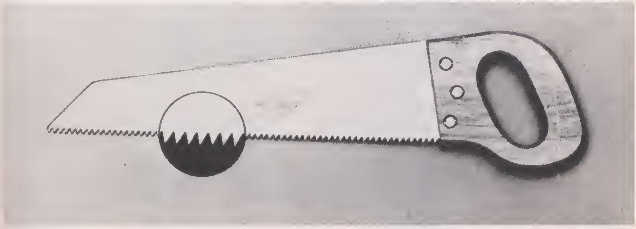
Hook-Bill Knife—Useful for trimming gypsum panels and for odd-shaped cuts. (Also known as linoleum knife.)



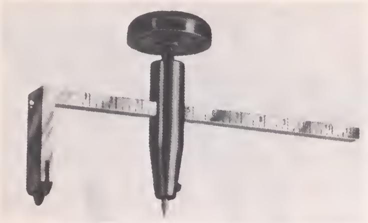
T-Square—4-ft. Square is indispensable for making accurate cuts across the narrow dimension of gypsum panels.



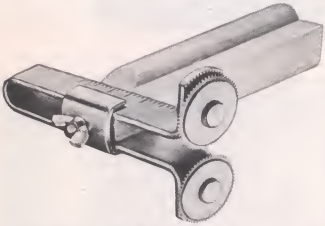
Utility Saw—Keyhole-style saw for cutting small openings and making odd-shaped cuts. Sharp point and stiff blade can be punched through board for starting cut.

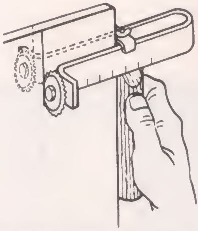


Drywall Saw—Short blade and coarse teeth (inset above) cut gypsum panels quickly and easily.

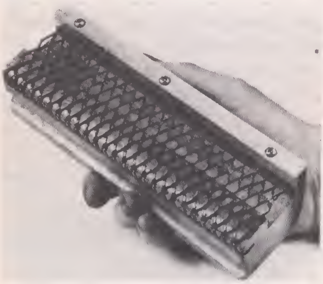


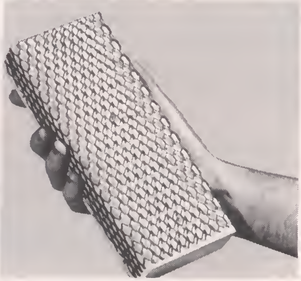
Circle Cutter—Calibrated steel shaft allows accurate cuts up to 16″ diameter. Cutter wheel and center pin are heat-treated.





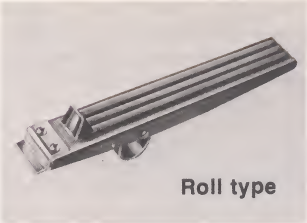
Gypsum Panel Stripper—For making narrow cuts in gypsum panels. Tool has two cutting wheels that cut both sides of panel simultaneously. Handle serves as edge guide and its position adjusts to make cuts up to 4½″ wide.





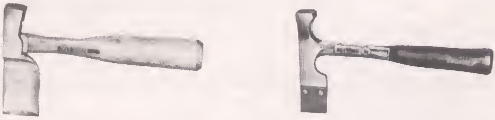
Rasp—Quickly and efficiently smooths rough-cut edges of gypsum panels. Manufactured model at left features replaceable blade and clean-cut slot to prevent clogging. Job-made model at right consists of metal lath stapled to a 2″×4″ wood block.

Light Box Cutter—Cuts exact hole shapes in gypsum panels for various types of electrical boxes. Does not damage surrounding gypsum core or paper facings.

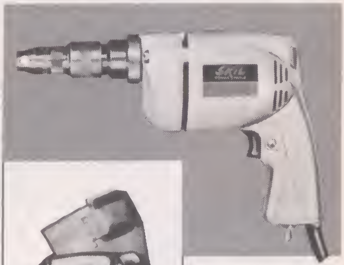


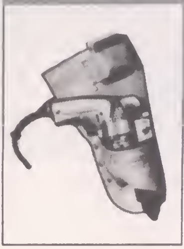
Gypsum Panel Lifter—Device is designed to move the panel forward as it lifts. Can be used for panels applied either perpendicular or parallel.

Drywall Hammer—Has symmetrical convex face designed to compress gypsum panel face and leave desired "dimple". Blade end is not for cutting but for wedging and prying panel. (Not for veneer bases, which require a tool with a flatter head.)

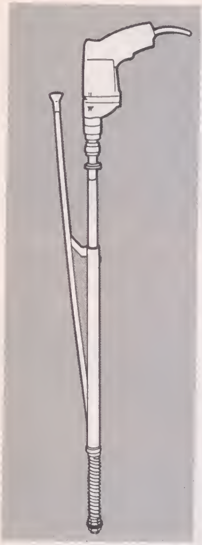


Lather's Hatchet—The standard nailing and cutting tool for gypsum lath. Available with fixed or replaceable knife edge.





Two types of power screw-guns, above, drive USG Screws in gypsum panel attachment or lamination. Screwgun holster (right) is worn on workman's belt.



Screwgun Adapter—Converts standard screwgun for easier, back-saving application of plywood to steel or wood floor joists. Use USG 1$\frac{15}{16}$" Type S-12 Bugle Head Pilot Point Screws.

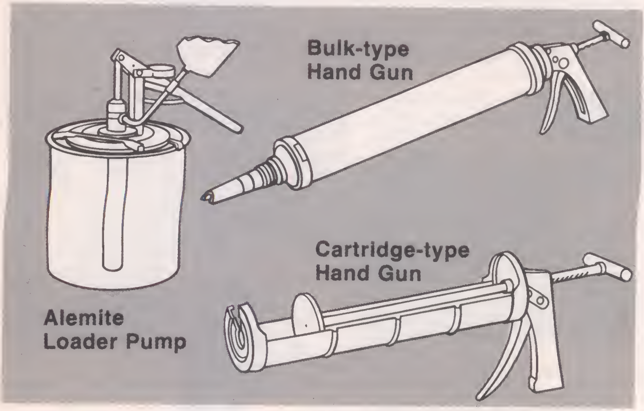
Pistol-Type Stapler—For attachment of THERMAFIBER Insulating Blankets to wood studs and to the inner face of gypsum panels in steel-framed assemblies. Also for attachment of corner beads, Striplath, Cornerite and IMPERIAL Tape.

Caulking Equipment—Both manual and power equipment are available for application of adhesives and acoustical sealants:

Cartridge-Type Hand Gun: Used with 30-oz. cartridges. Bead size is determined by cut of nozzle. Aids uniform application of adhesive. Applicator capacity: $\frac{1}{10}$ gal., 1 qt.

Bulk-Type Hand Gun: Has trigger mechanism, withstands rough usage and offers minimum resistance to large bulk load of adhesive. Applicator has 1-qt. capacity; may be filled using Alemite Loader Pump.

Note: Bulk guns and pumping equipment are often used to minimize pilferage of cartridges.

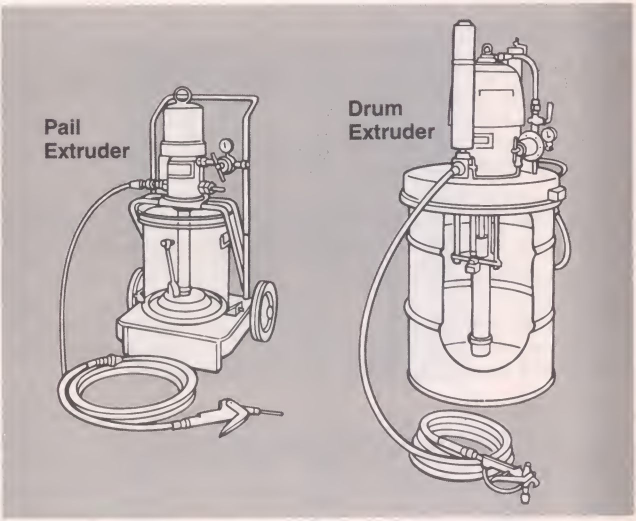


Alemite Loader Pump, Model 7537: Clamps on 5-gal. container to mechanically load bulk-type adhesive hand guns. Eliminates waste of hand and paddle loading.

Pumping Equipment: Because of their high-volume output, pumping machines provide greater efficiency and production in the transfer, flow and spray of adhesives. Nail and screw attachment are being supplemented or replaced by this type of adhesive application equipment in many building operations such as flooring, partitions and ceilings.

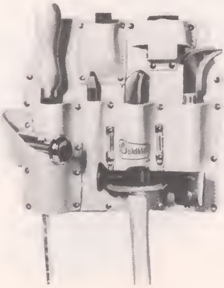
Large pumping equipment permits purchasing in bulk and high-volume application; contributes to job economy by reducing waste and application time.

Most machine dispensing systems are available with a selection of pumps, flow valves, nozzles and accessories. Equipment manufacturers offer a wide choice of components to provide the exact system for the job.



Pail Extruder: For high volume extrusion of adhesives from pails. Air power depends on viscosity (low, medium or high) of the material. Offered in portable or mobile units with pump, air regulators and gauge, pail ram, adapter and hose.

Drum Extruder: Comparable to pail extruder; used for high-ratio extrusion of adhesive from bulk containers.



Tool Pouch—Available in a variety of styles, tool pouches are designed to carry all of the common hand tools needed by the gypsum panel installer.

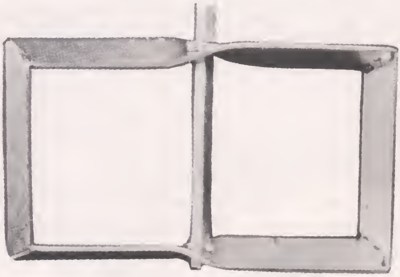
Nail Bag—Worn from the belt, these bags keep nails or screws within easy reach for fast production. Also available with extra pockets for small tools and with hammer loop.

Mixing Equipment

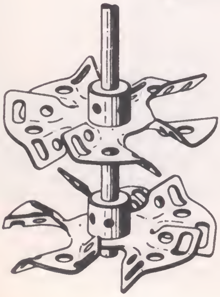
Joint Compound and Texture Mixing Paddle—While hand mixing of U.S.G. joint compounds and textures is adequate, many applicators prefer electric mixers. Power mixing saves considerable time, particularly on large jobs where mixing in a central location is most convenient.

Power is supplied by a ½" heavy-duty electric drill with a speed of *max. 400 rpm*. Drills that operate at high speeds will whip air bubbles into the mix, rendering it unfit for finish coat purposes.

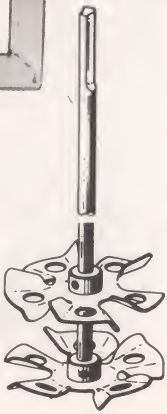
Mixing paddles are available in various styles, such as the typical examples shown below. Paddles designed for joint compounds and textures, however, should *not* be used for mixing veneer finishes. The latter require a special cage-type paddle that is illustrated on the page opposite.

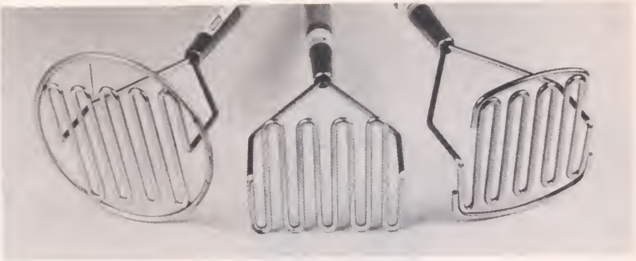


Joint Compound Paddle



Texture Paddles





Potato Masher—For hand-mixing joint compounds, available in several styles. Models shown at left and at right are especially effective for removing dry material from sides of mixing bucket.

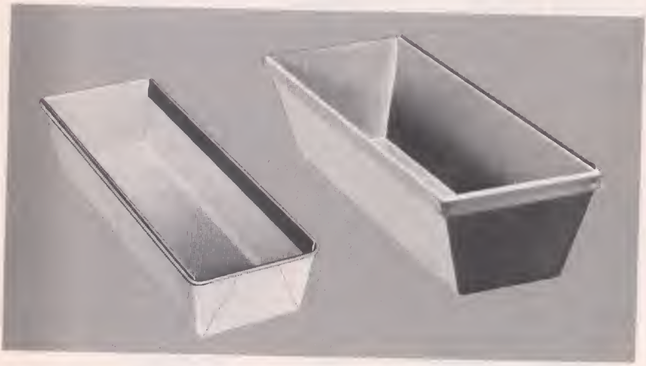
Veneer Plaster Mixer—The only mixer recommended for U.S.G. veneer finishes is shown above. This cage-type paddle provides high shear action, necessary for proper dispersion of plaster ingredients in mixing water, and to develop high plasticity in the mix. Operated at proper speed, the paddle mixes thoroughly, producing a virtually air-free plaster.

A heavy-duty ½″ electric drill with a no-load rating of 900 to 1,000 rpm is necessary to deliver sufficient power and speed for mixing U.S.G. veneer plasters.

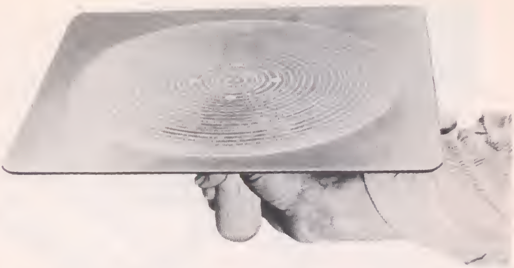
Plaster and Stucco Mixer—Standard paddle-type mixer for stucco and all conventional plasters (not suitable for veneer finishes) is illustrated at left. Available with capacities from 5 to 7 cu. ft. in either electric or gasoline-powered models.

Vertical Drum Mixers—These consist of an electric motor (which drives shaft-mounted paddles) mounted atop an open-end drum. Models are available for mixing double-hydrated lime and for joint compound. Lime mixers are made in one- and three-bag sizes, joint compound mixers in 16- and 30-gal. sizes.

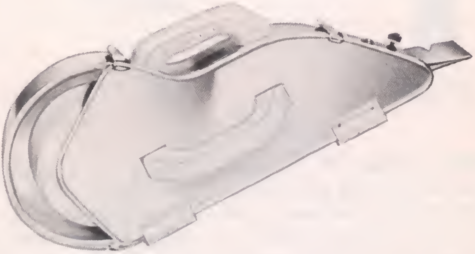
Finishing Tools



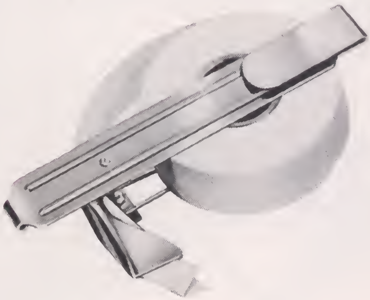
Mud Pan—Joint compound carrier for the hand finisher. Wide range of sizes, with or without a knife-cleaning blade. Available in plastic, stainless steel, galvanized steel and tinplate.



Hawk—Suitable for carrying any cementitious material by a hand applicator—joint compound, plaster, veneer finishes and stucco. Available in sizes from 8″×8″ to 14″×14″ and in aluminum and magnesium. (Smooth-surface model is preferred for joint compound.)



Banjo—Applies paper tape and joint compound simultaneously to flat joints. In two models: one stores tape and compound in separate compartments; the other stores tape and compound together.



Tape Dispenser and Creaser—Holds tape rolls up to 500 ft. Has built-in creaser to fold tape for corner application.

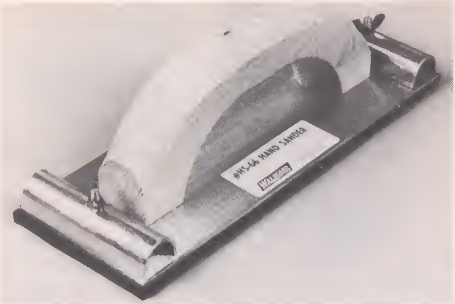
10″ Long-handle Drywall Knife

6″ Knife

4″ Knife

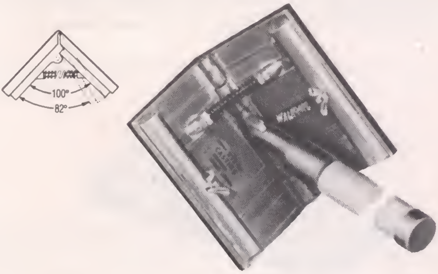
Taping Knives—4″, 5″ and 6″ knives are designed for taping, fastener spotting and angle taping and finishing, a 10″ knife for finish coating. All have square corners needed for corner work. The two narrower knives are available with either plain handle (shown on 4″ knife) or with hammerhead handle (shown on 6″ knife). Other drywall finishing knives are available with blade widths up to 24″. Long-handle models also available.

Interior Corner Tool—For embedding tape and applying joint compound to both sides of interior corner at the same time.

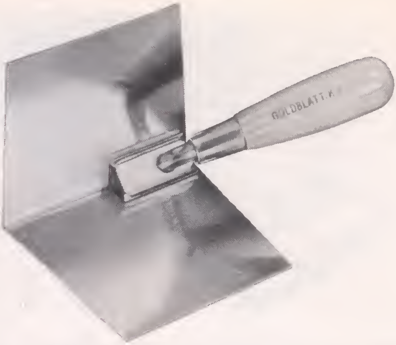


Hand Sander—3¼″×9¼″ base plate speeds joint sanding. Models available include those with wood or aluminum handles.

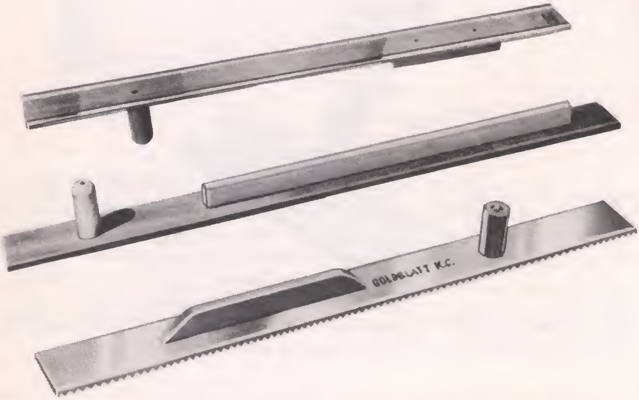
Pole Sander—Long handle permits sanding of ceiling joints without necessity of workman using stilts.



Universal Angle Sander—Spring-loaded center hinge adjusts this tool automatically to fit corner angles from 82° to 100° to sand both sides at same time.

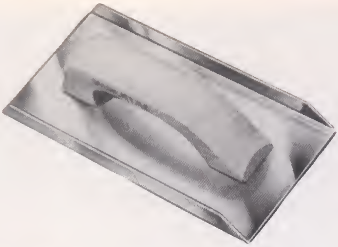


Angle Plow—For interior corner finishing of veneer jobs. Similar tool with narrower blades available for conventional plaster.

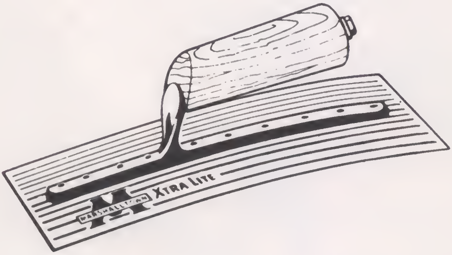


Darby—For smoothing or floating plaster brown coat. Also for finish coat where an especially true and even surface is desired. Made in wood, metal-edged wood or all metal. Notched darby at bottom is for undercoats.

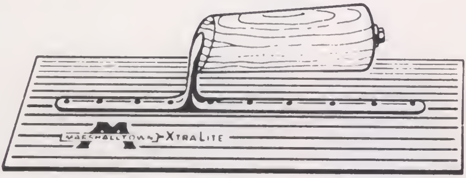
Float—For producing a sand-finish effect on plaster and veneer surfaces. Floats may be faced with sponge rubber (as shown), cork, felt or carpet.



Angle Float—Should not be confused with floats used to raise sand-float textures. Angle floats for corner work with conventional plasters are especially useful for brown coat work.



Trowels—Available in several styles and in lengths from 10″ to 16″. *Curved* trowels are preferred by many drywall tapers because the blade has a shallow curve (approx. 5⁄32″ deep) that helps feather and finish joints to a low, inconspicious crown.



Flat trowels are the standard tools for veneer and conventional plaster work.

Taping and Finishing Tools—Sometimes called "mechanical" tools, this line of equipment includes specialized tools for every phase of drywall joint treatment work.

Automatic Taper: Applies tape and proper amount of joint compound simultaneously to flat joints or corners. Designed for high-volume machine tool application.

Corner Roller: Used to embed tape in corner and force excess compound from under tape prior to finishing.

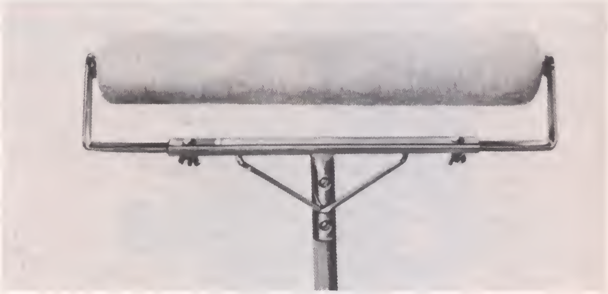
Corner Finisher: Distributes excess compound evenly over tape and feathers edges.

Hand Pump: Fills mechanical tools from 5-gal. pail.

Flat Applicator: Applies compound for hand application of tape.

Finishing Tools: Used for application of successive coats of joint compounds. Also used for mechanical tool application of COVER COAT Compound.

Manual Texturing Equipment

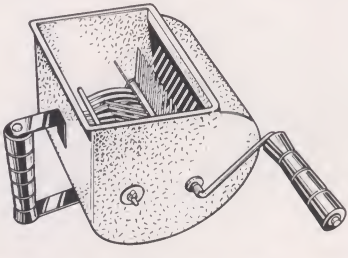


Mud-Roller—For roll-on textures and stipples. Heavy-duty construction permits heavy pressure when needed. Long handle allows applicator to work from floor. Rollers available in nap lengths ranging from very short for stipples to long "sheepskin" for heavy texture, and in widths to 18".

Mud-Roller Pan—For use with mud-roller described above. Holds 25-lb. supply of mixed joint compound or texture.

Texture Brush—Available in many styles and sizes, tandem-mounted brushes cover large area to speed texturing job.

Glitter Gun—For embedding glitter in wet texture or wet plaster ceilings. Hand-crank model shown is most economical but is not as efficient as air-powered type (not shown).



Texture Patcher—For patching scratched or marred textured ceilings and walls. Both material flow and size of texture can be regulated.

Other Texture Tools—A wide variety of tools and materials can be used to produce interesting and unusual texture finishes.

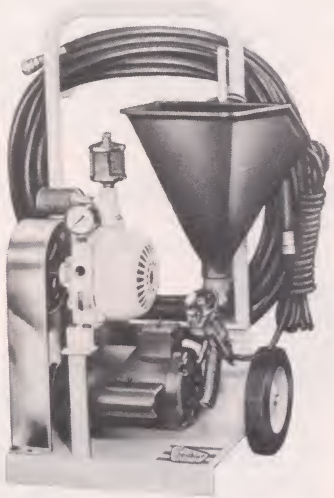
Spray Texturing Equipment

While it is difficult to make a clear-cut distinction, the spray-texture equipment described in this section is divided into two categories: (1) equipment designed primarily to spray drywall texture materials only, and (2) universal equipment designed to handle drywall textures as well as veneers and plasters.

For U.S.G. Texture Products, spray application techniques vary depending upon the product and desired finish. Recommendations for air pressures, orifice sizes, hose sizes and application rates for these products can be found in Chapter 2.

drywall spray texture equipment

Hopper Gun and Compressor



Hopper Gun—This machine, with a spray gun and material hopper mounted together to form an integral unit, handles all types of drywall texture materials. Compressed air forces material through the hose to the gun nozzle where it is atomized.

The same type of gun is also available with larger motor and compressor. This model has sufficient capacity to feed two hopper guns.

A third and heavier-duty type of texture machine features a material pump. The gun furnished with this model is hopperless and accepts two hoses—a material hose and an air hose. A separate compressor is required.

hoses and guns

Hoses—Used to carry material from pump to nozzle, they vary in type and generally have a diameter of 1″ to 2″. Larger hoses—or preferably, pipe—can be used to carry material when the vertical pumping distance reaches several hundred feet.

Pole Guns—Can be used with any of universal spray machines

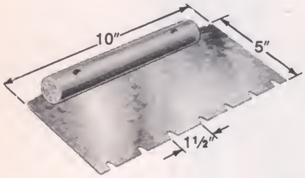
as well as largest of drywall texture machines. Their length allows an operator to spray moderately high ceilings without scaffolding or stilts.

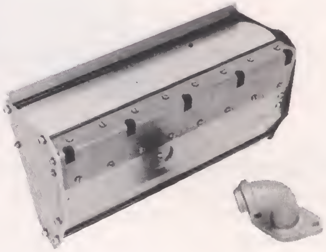
universal spray machines

When machine speed, air pressure and/or nozzle are adapted to material used, equipment in this group can handle drywall textures, veneer finishes and conventional plasters, stucco and fireproofing materials.

In selecting new equipment of this type, a number of factors must be considered: the type of material to be sprayed, type of finish desired, output volume required, the distance (horizontally and vertically) that the material is to be pumped, and portability. (In this instance, portability refers to the ability to move a machine through the halls and doorways in a building.)

Miscellaneous Equipment



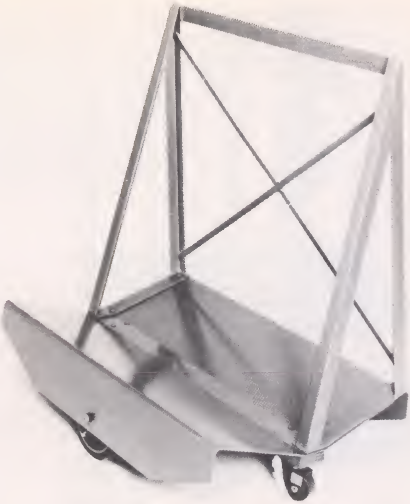


Joint Compound and Adhesive Spreaders—Made either commercially or by the applicator himself, these are used for applying joint compound in laminated gypsum panel assemblies.

Spreaders such as shown above at left are easily made on the job. Stainless or galvanized sheet steel make the best spreaders. Other materials are *not* satisfactory because compound tends to accumulate and dry in the notches. A good spreader blade has about the same stiffness as a plasterer's trowel.

Notches should be of an inverted "V" shape, ½″ deep, ⅜″ wide at the base and spaced 1½″ to 2″ o.c. A piece of wood dowel or window stop attached near top edge of blade provides a grip.

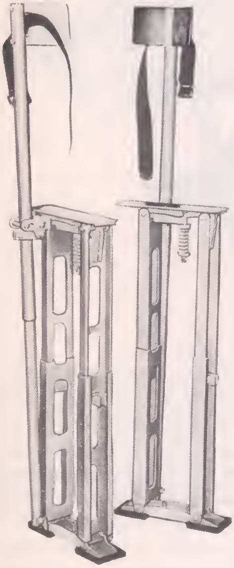
The tool shown at right is a laminating spreader which applies properly sized beads of adhesive at correct spacings.

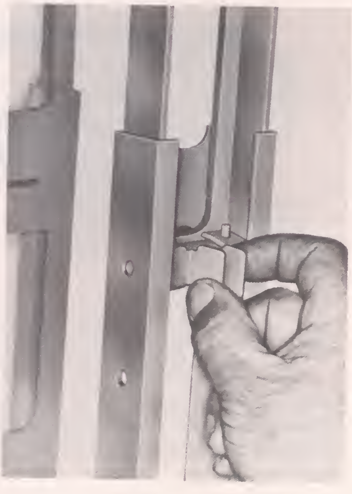


Gypsum Board Dolly—For efficient transport of gypsum panels around the floors of a building. The load, centered over large side wheels, is easily steered and moved by one man.

Folding Trestle—Top surface, 9½″×48″, provides work surface or stand-on work platform. Legs adjust from 18″ to 32″ in 2″ increments.

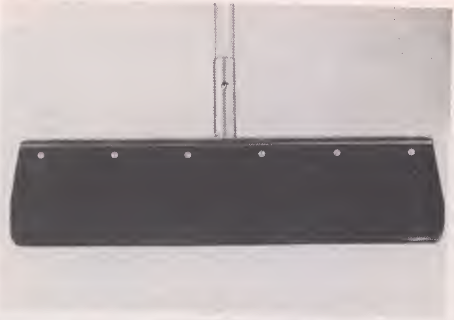
Midget Scaffold—Portable and easy to set up, small scaffolds are ideal for jobs that do not require full scaffolding.





Stilts—Eliminate the need for scaffolding on most drywall, veneer and plaster jobs. Give applicator full mobility plus the height needed for ceiling work. Some stilts have articulated joints to flex with ankle movement. Available in fixed-height and adjustable-height types (adjustable, articulated model shown).

Spray Shield—36″ wide aluminum shield protects abutting wall or ceiling against overspray during spraying operation.



Wall and Floor Scrapers—*Both tools have hardened steel blades and long handles to speed cleaning of walls and floors after application of joint compound, plaster or texture materials. Wall scraper (top photo) has rounded corners to avoid gouging.*

chapter 9

common problems—equipment—appendix and glossary

appendix

Technical data given in this chapter apply only to the U.S.G. products described in this manual.

agencies and associations

AGC	Associated General Contractors of America 1957 E St., N.W. Washington, D.C. 20006
AIA	The American Institute of Architects 1735 New York Ave. N.W. Washington, D.C. 20006
A Ins. A	American Insurance Association 85 John St. New York, N.Y. 10038
AISI	American Iron & Steel Institute 1000 Sixteenth St. N.W. Washington, D.C. 20036
ANSI	American National Standards Institute 1430 Broadway New York, N.Y. 10018
APA	American Plywood Association P.O. Box 11700 Tacoma, Wash. 98411
ASC	Adhesive and Sealant Council 1600 N. Wilson Blvd. Suite 910 Arlington, Va. 22209
ASHRAE	American Society of Heating, Refrigerating & Air Conditioning Engineers, Inc. United Engineering Center 345 E. 47th St. New York, N.Y. 10017
ASTM	American Society for Testing & Materials 1916 Race St. Philadelphia, Penna. 19103

AWCI	Association of the Wall & Ceiling Industries International 25 K Street, N.E. Washington, D.C. 20002
BIA	Brick Institute of America 1750 Old Meadow Road McLean, VA 22102
BOCA	Building Officials & Code Administrators International, Inc. 17926 S. Halsted St. Homewood, Ill. 60430
CABO	Council of America Building Officials 560 Georgetown Bldg. 2233 Wisconsin Ave., N.W. Washington, D.C. 20007
CISCA	Ceilings & Interior Systems Contractors Association 1800 Pickwick Ave. Glenview, Ill. 60025
FMS	Factory Mutual System 1151 Boston-Providence Tpke. Norwood, MA 02062
GA	Gypsum Association 1603 Orrington Ave. Suite 1210 Evanston, Ill. 60201
GSA	General Services Administration 18th & F Streets N.W. Washington, D.C. 20405
HUD	Dept. of Housing & Urban Development Federal Housing Administration Washington, D.C. 20411
ICBO	International Conference of Building Officials 5360 South Workman Mill Rd. Whittier, Calif. 90601
ML/SFA	Metal Lath/Steel Framing Association 221 N. LaSalle St. Chicago, IL 60601
NAHB	National Association of Home Builders 15th & M Streets N.W. Washington, D.C. 20005
NCSBCS	National Conference of States on Building Codes and Standards 481 Carlisle Drive Herndon, VA 22070
NEMA	National Electrical Manufacturers Association 2101 L St., N.W. Washington, D.C. 20037

NFiPA	National Fire Protection Association 470 Atlantic Ave. Boston, Mass. 02110
NLA	National Lime Association 5010 Wisconsin Ave., N.W. Washington, D.C. 20016
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, Ill. 60077
SBCC	Southern Building Code Congress International 900 Montclair Rd. Birmingham, Ala. 35213
TCA	Tile Council of America Research Center P.O. Box 326 Princeton, N.J. 08540
TPI	Truss Plate Institute 2400 E. Devon Ave. Des Plaines, IL 60018
WHI	Warnock Hersey International Inc. P.O. Box 1078 Antioch, CA 94509

rating fire endurance

(ASTM E119, UL 263 and NFPA 251)

This is the standard test for rating the fire resistance of columns, girders, beams, and wall-partition, floor-ceiling, and roof-ceiling assemblies. It is published by three organizations, designated above, and is essentially the same for all three.

The test procedure consists of the fire endurance test for all assemblies (not individual products) and, in addition, a hose stream test for partition and wall assemblies. The test specimen assembly must meet the following requirements to pass the test.

1. The structural elements subjected to the test must support the maximum design loads applied throughout the test period. Columns, beams, girders and structural decks must carry the load without failure.

   This test does not imply that the test specimen will be suitable for use after the exposure. Some specimens are so damaged after one hour of exposure that they would require replacement, even though they meet all of the requirements for a 4-hr. rating.

2. No openings may develop in an assembly which will permit flames or hot gases to penetrate and ignite combustibles on the other side.

3. An assembly must resist heat transmission so that temperatures on the side opposite the fire may be maintained below

designated values. The temperature of the unexposed surface is measured by thermocouples covered with dry asbestos pads attached directly to the surface. In the case of walls and partitions, one thermocouple is located at the center of the assembly, one in center of each quarter-section, and the other four at the discretion of the testing authority.

The hose stream test consists of subjecting a duplicate sample to one-half of the indicated fire exposure (but not more than one hour), then immediately to a stream of water from a fire nozzle at a prescribed pressure and distance. This test simulates the effect water would have on the exposed surface under real fire conditions. If there is a breakthrough on the unexposed side, sufficient to pass a stream of water, the result is test failure.

Conditions for Hose Stream Test

resistance period	water pressure at base of nozzle		duration of application, min. per 100 ft² (9.29m²) exposed area
	lbf/in²	kPa	
8 hr. and over	45	310	6
4 hr. and over if less than 8 hr.	45	310	5
2 hr. and over if less than 4 hr.	30	207	2½
1½ hr. and over if less than 2 hr.	30	207	1½
1 hr. and over if less than 1½ hr.	30	207	1
Less than 1 hr., if desired	30	207	1

The time-temperature curve used for the fire endurance test is shown on opposite page. The temperature of the furnace is obtained from the average readings of nine thermocouples, symmetrically located, and placed 6″ from the exposed surface of walls and partitions or 12″ from the exposed surface of floors, ceilings and columns.

Surface Burning Characteristics

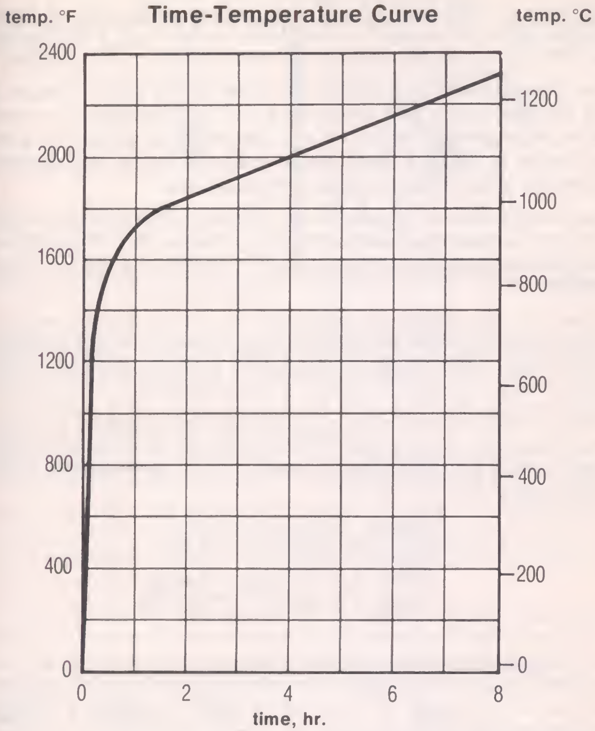
(ASTM E84, ANSI 2.5, NFPA 225 and UL 723)

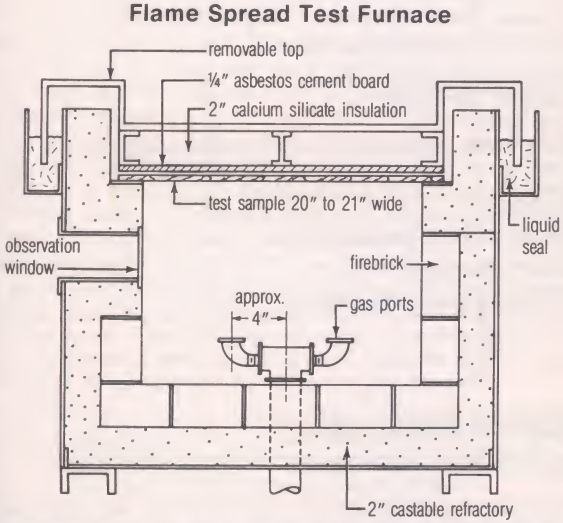
The characteristics of interior finish materials that are related to fire protection are:

—Ability to spread fire
—Fuel contributed to the fire
—Quantity of smoke developed when burning

Materials that have high flame spread, contribute substantial fuel and/or produce large quantities of smoke, are considered undesirable, especially when used in areas where people assemble or are confined.

The flame spread test (Surface Burning Characteristics of Building Materials) is often referred to as the Steiner Tunnel Test, after its originator.





In the test, a 20″ × 25-ft. sample, forming the roof of a rectangular furnace, is subjected to a fire of controlled severity,

placed 12″ from one end of the sample (the point of flame contact with the sample is considered to be 4½ ft. from the fire, so the test is actually conducted over 19½ ft. of the sample).

The time required for the flame to travel the 19½ ft. to the end of the sample, along with the smoke and heat produced, is compared with similar figures for red oak which is arbitrarily given the value of 100 for these three characteristics, and cement-asbestos board which is given the value of 0.

Fuel contribution is measured by means of thermocouples, and the smoke developed is monitored by means of a photoelectric cell connected to an ammeter which indicates changes in smoke density.

Obviously, the indices developed in the tunnel test are relative, but enough is known about the burning characteristics of materials to make these indices reliable for building code specifications.

Most building codes divide materials into four classes, based on the *Flame Spread Indices*. The numbering and range of each class varies with the different codes, but they generally follow this pattern:

Class I (Class A)—0-25
Class II (Class B)—26-75
Class III (Class C)—76-200
Class IV (Class D)—over 200

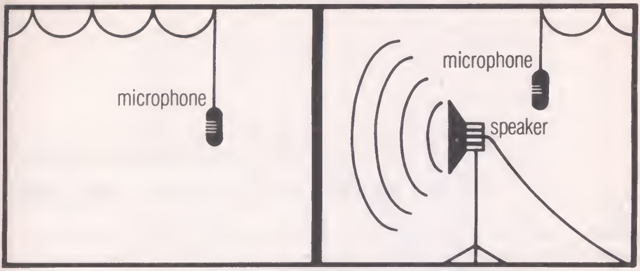
Surface Burning Characteristics (per ASTM E84-75)

product	flame spread	fuel contributed	smoke developed
SHEETROCK Brand Gypsum Panels	15	15	0
USG Exterior Gypsum Ceiling Board	20	5	0
SHEETROCK Brand W/R Gypsum Panels	20	5	0
TEXTONE Vinyl-Faced Gypsum Panels			
Woodgrain, Cork Patterns	20	5	15
Linen Pattern	25	5	60
Textile Pattern	25	10	65
Pumice	20	20	10
Suede	15	10	25
Sandalwood	15	20	10
THERMAFIBER Sound Attenuation Blankets	15	0	0
THERMAFIBER Z-Furring Blankets	15	0	0
THERMAFIBER Flame-Resistant Blankets	10-25	5	0

determination of sound transmission class (STC)

The testing for airborne sound transmission is performed under rigidly established procedures set up by the American Society for Testing and Materials (ASTM procedure E90-75). Several

Sound Test Sample Assembly



independent acoustical laboratories across the nation are qualified to perform the tests. While all are presumably reliable and follow the ASTM procedure, the results tend to vary slightly. For this reason, test results from more than one laboratory should never be compared on an exact basis.

The tests are conducted on a sample assembly which is at least 8×8 ft. in size. The assembly is installed between two rooms constructed in such a way that sound transmitted between the rooms by paths other than through the assembly is insignificant. The background noise in the rooms is monitored to ensure it does not affect the test results.

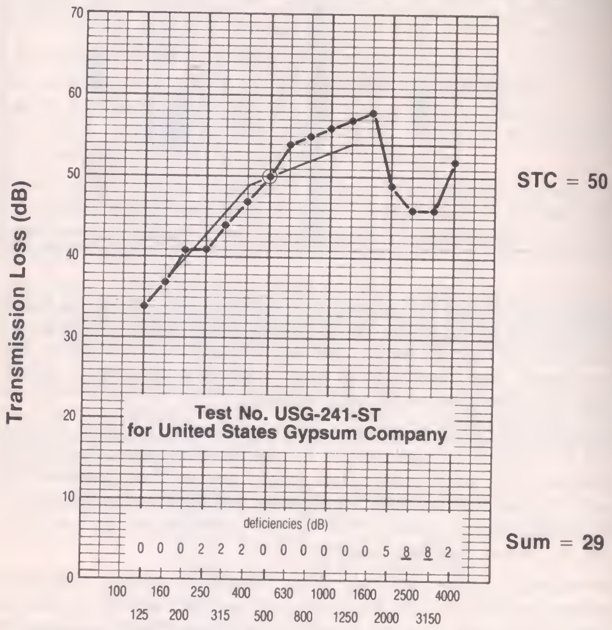
The sound source consists of an electronic device and loudspeaker which produce a continuous random noise covering a minimum frequency range of 113 to 4,450 Hz (Hertz—cycles per second). Panel diffusers and/or rotating vanes are set up so the noise is diffused and the sound level is measured at several microphone positions in each room; readings are taken at sixteen ⅓-octave frequency-band intervals. Average sound levels in the receiving room are subtracted from the corresponding sound levels in the source room and the differences (the sound levels of the actual transmission) are recorded as transmission-loss values (adjustments are made for test room absorption and test assembly size).

These transmission-loss values are then plotted on a frequency band-sound pressure level graph and the resulting curve is compared to a standard criterion curve. The *Sound Transmission Class* (STC), as defined by the rating procedure set forth in ASTM E413-73T, is determined by adjusting the criterion curve vertically until the decibel (dB) total of all frequency bands on the test curve that are below the criterion curve does not exceed 32, and no point on the test curve is more than 8 dB below the criterion curve. Then, with the criterion curve adjusted to meet these standards, its transmission loss at 500 Hz (500 cycles per second) is taken as the STC (dropping the dB unit).

An alternative procedure, frequently used for the measurement of sound transmission loss under field conditions, is given in ASTM Standard Test Method E336-77. This may be used to obtain a Field Sound Transmission Class (FSTC).

Reproduced on the next page is the graph of an actual sound transmission-loss test of a drywall partition, Test No. USG-241-

Determination of Sound Transmission Class
per ASTM E413-73T



One-third Octave Band Center Frequency in Hz

ST. The partition is rated at STC 50 with the criterion curve adjusted to meet the standards outlined above. The deficiencies at 2,500 Hz and 3,150 Hz are 8, the allowable maximum.

The total of all points below the criterion curve is 29, three points less than the 32 allowed.

The criterion curve itself is plotted to allow for subjective human response to sound pressure at the 16 frequency bands measured. Because the human ear is less sensitive to low-frequency sound pressure than to high frequencies, the criterion curve has been adjusted to allow some additional noise at low frequencies. This is done to avoid down-rating test results because of noise levels that are least objectionable to people. The ASTM test procedure explains the use of STC in the following excerpt from E413:

> "The purpose of this classification is to provide a single-figure rating that can be used for comparing partitions for general building design purposes. The rating is designed to correlate with subjective impressions of the sound isolation provided against the sounds of speech, radio, television, music and similar sources of noise in offices and dwellings.
>
> "Excluded from the scope of this classification system are applications involving noise spectra that differ markedly from those described above. Thus, excluded for example would be

noises produced by most machinery, certain industrial processes, bowling alleys, power transformers and the like."

determination of impact insulation class (IIC)

Impact sound originates when one body strikes another, such as in the case of footsteps, hammering and objects falling. Even though some of the sound energy is eventually conducted to the air, the sound is still classified as impact.

Impact sound travels through the structure with little loss of energy if the structure is continuous and rigid. Thus, tenants without enough heat can pound on a radiator and notify the superintendent (and all other tenants as well) of the situation.

Transmission of impact sound can be controlled by isolation, absorption and elimination of flanking paths, and offset by the introduction of masking sound. Limpness in the construction affects transmission of impact sound, but is difficult to introduce because of the structural requirements of the assembly.

Mass plays a secondary role in the isolation of impact sound. The benefit of mass in a sound-control construction is its resistance to being set into vibration. In retarding airborne sound, this is very effective because the sound energy is small. With impact sound, the energy is greater and is applied directly to the construction by the sound source with little energy loss. Thus, the mass of that surface is immediately set into motion. For this reason, concrete slab construction at 100 $lb/ft.^2$ is only slightly more effective in retarding impact sound than simple wood frame construction at 10 $lb/ft.^2$

While leaks in a floor-ceiling assembly must be sealed to stop the transmission of the airborne sound associated with impact, they play little part in retarding the transmission of the structure-borne sound.

absorbing impact sound

The use of sound attenuation blankets is as effective in controlling impact sound as for airborne sound. Of course, unless the opposite surfaces of the assembly (floor and ceiling) are isolated or decoupled, sound travels through the connecting structure.

structural flanking paths

One of the most frequent causes of sound performance failure in a floor-ceiling assembly is flanking paths. Impact sound produces high energy at the source; this energy will follow any rigid connection between construction elements with little loss. For example, in a child's tin-can telephone, sound will travel better through the tight string stretched between the cans than through the surrounding air.

Some of the most common flanking paths are supplied by plumbing pipes, air ducts and electrical conduit rigidly connected between floor and ceiling. Continuous walls between floors, columns or any other continuous structural elements will act as flanking paths for impact sound. In fact, any rigid connection between the two diaphragms will transmit impact sound.

methods of impact rating

Assemblies designed to retard the transmission of impact sound are tested for performance as prescribed by ASTM Standard Method E492-77. The floor-ceiling assembly is constructed between two isolated rooms, and microphones are positioned in the receiving room to record the pressure of the transmitted sound.

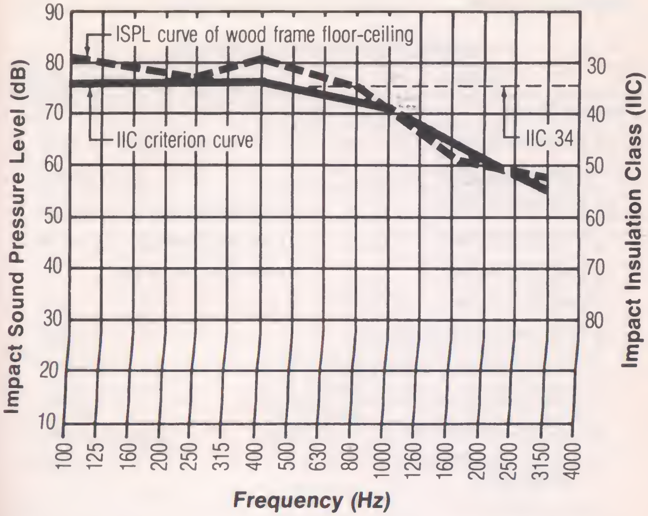
The impact sound source is a standard tapping machine. It rests on the floor of the test assembly and drops hammers at a uniform rate and impact energy. The sound produced depends to a large extent on the floor surface material. Carpet and pad, for example, greatly improve IIC ratings. The transmitted sound is measured and recorded at several microphone locations and four locations of the tapping machine. The results are corrected to a standard absorption so that results from different laboratories may be compared.

The results, recorded at sixteen ⅓-octave bands, are plotted and compared with a standard criteria curve in much the same manner as Sound Transmission Class determinations, except that the deficiencies lie above the curve.

Impact sound rating methods were established by the Federal Housing Administration (now HUD). The earliest was a single-number rating system called Impact Noise Rating (INR) and published in FHA 750.

The current HUD rating system is described in E492-77. To determine this *Impact Insulation Class* (IIC), the ISPL curve is plotted on a graph as shown on opposite page. The criterion curve is then shifted to the lowest point where no point on the ISPL curve is more than 8 dB above it, and the sum of all ISPL

United States Gypsum's Acoustical Research Facility at Round Lake, Ill.



deviations above it is no more than 32 dB. The location of the criterion curve at 500 Hz is projected to the IIC scale, right of graph, to read IIC Rating.

The IIC relates to STC ratings with respect to acceptability, and is a positive number. IIC values will usually be 51 points above the corresponding former INR values, but some deviations can occur. Tests must be analyzed individually against IIC criteria.

ASTM Standard Method E492-77 cautions that discretion must be exercised in using single figure rating, especially for performance criteria purposes.

permeance—U.S.G. products

Moisture Vapor Permeance

product[1]	finish	perms[2][3]
Gypsum Panels		
3/8" SHEETROCK Brand		35.3
1/2" SHEETROCK Brand		34.2
1/2" SHEETROCK Brand	1 coat flat latex paint	28.3
1/2" SHEETROCK Brand	2 coats flat latex paint	28.4
1/2" SHEETROCK Brand	2 coats gloss enamel (oil)	1.0
5/8" SHEETROCK Brand		26.6
5/8" SHEETROCK Brand FIRECODE		28.6
1/2" SHEETROCK Brand FIRECODE "C"		31.8
5/8" SHEETROCK Brand FIRECODE "C"		25.9
1/2" SHEETROCK Brand W/R		30.2
5/8" SHEETROCK Brand W/R FIRECODE "C"		26.7
1/2" TEXTONE		
Woodgrain Pattern		0.6
Cork Pattern		0.8
Linen Pattern		0.5
Textile Pattern		1.0
Pumice Pattern		0.8
Suede Pattern		0.6
Sandalwood Pattern		0.8
1" USG Shaft Wall Liner		24.0
Gypsum Sheathing		
1/2" USG Reg. Sheathing		23.3
Gypsum Base		
1/2" IMPERIAL		28.8
1/2" IMPERIAL	DIAMOND Interior Finish	24.4
1/2" IMPERIAL	1 coat IMPERIAL Finish	5.3
1/2" IMPERIAL	IMPERIAL Basecoat/ IMPERIAL Finish	8.0
1/2" IMPERIAL FIRECODE "C"		30.0
5/8" IMPERIAL		26.9
5/8" IMPERIAL FIRECODE "C"		26.2
3/8" gypsum base and 1/2" gypsum plaster; metal lath and 3/4" gypsum plaster		20.0
Building Insulation		
THERMAFIBER Reg. Blankets (Asphalted Kraft Vapor Retarder)		less than 1.0
FOAMULAR Extruded Polystyrene Insulation		0.7

(1)All foil-back products, less than 0.06 perm; (2)All tests comply with ASTM C355 (desiccant method); (3)Grain per sq. ft. per hr. per in. of mercury vapor pressure difference (grain/ft² · h · in · Hg.).

specification standards

The listings following contain existing Standard Specifications, classified as Federal, Army, Navy, Treasury, etc. which apply to U.S.G. materials described in this manual. Where ASTM, local codes, etc. require product variance, consult your U.S.G. representative. The symbol "WC" after a product listing denotes that U.S.G. is on the government list of those companies willing to certify that their products meet that specification. For specification standards for other U.S.G. products, refer to the complete listing in the U.S.G. Construction Selector SA-100.

product	federal specification	ASTM designation
Plaster		
RED TOP gypsum plaster (WC)	SS-P-00402B type II class 1 & 2	C28—gypsum neat plaster
RED TOP two-purpose plaster	SS-P-00402B type II class 1 & 2	C28—gypsum neat plaster
RED TOP wood fiber plaster (WC)	SS-P-00402B type III	C28—gypsum wood fiber
STRUCTO-LITE plaster	SS-P-00402B type I	C28—gypsum ready-mix plaster
perlite aggregate	non-applicable	C35
RED TOP gauging plaster (WC)	SS-P-00402B type V	C28—gypsum gauging for finish coat
RED TOP keenes cement		
regular (WC)	SS-C-161A type I	C61
quick trowel	SS-C-161A type II	C61
STRUCTO-GAUGE plaster	SS-P-00402B type V with added req. of dry compressive strength not less than 5000 psi (neat)	C28—gypsum gauging for finish coat
STRUCTO-BASE plaster	SS-P-00402B type II class 1 & 2 with added req. of dry compressive strength not less than 2800 psi	C28—gypsum neat plaster
IMPERIAL plaster	SS-P-00402B type VI	C587—gypsum veneer plaster
Lime		
RED TOP and GRAND PRIZE finish limes	SS-L-351B type F (including added requirement of not more than 8% unhydrated oxides)	C6 type N
IVORY finish lime		C206 type S
RED TOP masons hydrate	SS-L-351B type M (including added requirement of not more than 8% unhydrated oxides)	C207 type N
MORTASEAL masons lime BONDCRETE masons lime		C207 type S
Gypsum Bases		
ROCKLATH plaster base—⅜" & ½"	SS-L-30D type I grades R and X, class 1, forms (a) and (c), style 5	C37

(table continued on next page)

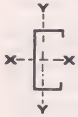
Specification Standards continued

product	federal specification	ASTM designation
Gypsum Bases continued		
IMPERIAL gypsum base—½" & ⅝"	SS-L-30D type VI, grades R and X, class 1, style 1	C588
USG R.H. base—½" & ⅝"	SS-L-30D type VI grades R and X class 1, style 1	C588
Metal Lath & Studs		
Bases, metal: (for) plaster, lath and stucco constr. (WC) 3.4# galv. diamond mesh lath, 2.5# and 3.4# ptd. ⅛" 4-mesh z-riblath 2.75# and 3.4#; ⅜" riblath 3.4#; stuccomesh	QQ-L-101C class 3 (flat diam. mesh) class 3 (self-furring diam. mesh) class 4 (⅛" flat rib) class 1 (⅜" rib) class 6 (stuccomesh)	D847 (metal lath only)
Hanger wire—tie wire	QQ-W-461H class 1 finish 5 (1006 type steel)	
TRUSSTEEL studs	QQ-W-461-H	
Gypsum Panels		
SHEETROCK brand (plain) (foil-back)	SS-L-30D type III grade R class 1 forms A & C	C36
SHEETROCK brand sq. edge (WC)	SS-L-30D type III grade R cl 1 style 1	C36
SHEETROCK brand tap. edge (WC)	SS-L-30D type III grade R cl 1 style 3	C36
SHEETROCK brand bev. edge (WC)	SS-L-30D type III grade R cl 1 style 4	C36
⅝" SHEETROCK brand FIRECODE	SS-L-30D type III grade X class 1	C36
SHEETROCK brand FIRECODE "C"	SS-L-30D type III grade X class 1	C36
TEXTONE vinyl-covered	SS-L-30D type III grade R or X class 3	C36
SHEETROCK brand W/R water-resistant	SS-L-30D type VII grade W or X class 2	C630
USG coreboard USG liner panels	SS-L-30D Type IV grade R or X class 1	C442
USG exterior gypsum ceiling board	—	C931
Sheathing		
USG gypsum sheathing GYP-LAP sheathing USG triple-sealed sheathing	SS-L-30D type II grade R class 2	C79

product	federal specification	ASTM designation
Joint Treatment		
USG & DURABOND joint compounds	SS-J-570B type I and type II	C475
Drywall & Plaster Accessories		
USG steel studs, runners, furring channels, RC-1 resilient channels	QQ-S-775E type I class f (steel)	A568 (steel) C645 (except STL studs, CRL runners and RC-1 resilient channels) A525 (galv. coating) A463 (alum. coating)
Metal corner beads and trim	QQ-S-775E class f (steel)	A525 (galv. coating)
USG drywall screws SUPER-TITE screws	—	C646
Mineral Fiber Insulation		
THERMAFIBER		
open-face batt (membrane facing one side)	HH-I-521F type II, III	C665
blanket batt (with enveloping membranes)	HH-I-521F type II, III	C665
blowing wool	HH-I-1030B type I cl. A	none
pouring wool	HH-I-1030B type II cl. A	none
sound attenuation blanket	HH-I-521F type I	C665
THERMAFIBER safing insulation, curtain wall insulation, mineral felt fireproofing	HH-I-521F type I HH-I-558B form A, classes 1 & 2	C665
Polystyrene Insulation		
Extruded foam panels	HH-I-524C type IV	—

structural properties—steel studs

Structural Properties—USG Steel Studs

stud system	stud designation[1]	I_x in^4	S_x in^3	r_x in	I_y in^4	S_y in^3	r_y in
	158ST	0.038	0.044	0.678	0.019	0.023	0.484
	212ST	0.103	0.076	1.012	0.020	0.023	0.480
	358ST	0.243	0.125	1.415	0.021	0.024	0.464
	400ST	0.307	0.143	1.544	0.021	0.024	0.458
	600ST	0.810	0.255	2.208	0.021	0.024	0.426
	158STL	0.032	0.036	0.678	0.013	0.019	0.480
	212STL	0.083	0.060	1.012	0.013	0.019	0.476
	358STL	0.206	0.105	1.414	0.018	0.021	0.460
	212CWS	0.186	0.147	1.005	0.040	0.045	0.472
	358CWS	0.441	0.241	1.406	0.045	0.046	0.457
	400CWS	0.556	0.275	1.536	0.046	0.046	0.451
	600CWS	1.472	0.487	2.198	0.047	0.047	0.419

[1]Indicates size and style: 158—1⅝"; ST, STL and CWS—stud.

Structural Properties—TRUSSTEEL Studs

stud size	major axis			minor axis		
	I_x in^4	S_x in^3	r_x in	I_y in^4	S_y in^3	r_y in
1⅝"	0.052	0.064	0.725	.0033	.0123	.1824
2½"	0.132	0.106	1.162	.0033	.0123	.1824
3¼"	0.231	0.142	1.537	.0033	.0123	.1824
4"	0.365	0.183	1.916	.0033	.0123	.1824
6"	0.831	0.277	2.912	.0033	.0123	.1824

thermal and hygrometric expansion of building materials

Thermal Coefficients of Linear Expansion of Common Building Materials

unrestrained 40°—100°F. (4°—38°C.)

material	coefficient	
	$\times 10^{-6}$ in/(in·°F)	$\times 10^{-6}$ mm/(mm·°C)
Gypsum Panels and Bases	9.0	16.2
Gypsum Plaster (sanded 100:2, 100:3)	7.0	12.6
Wood Fiber Plaster (sanded 100:1)	8.0	14.4
Aluminum, Wrought	12.8	23.0
Steel, Medium	6.7	12.1
Brick, Masonry	3.1	5.6
Cement, Portland	5.9	10.6
Concrete	7.9	14.2
Fir (parallel to fiber)	2.1	3.8
Fir (perpendicular to fiber)	3.2	5.8

Hygrometric Coefficients of Expansion (unrestrained)

Inches/Inch/% R. H. (5%—90% R. H.)

Gypsum Panels and Bases	7.2×10^{-6}
Gypsum Plaster (sanded 100:2, 100:3)	1.5×10^{-6}
Wood Fiber Plaster (sanded 100:1)	2.8×10^{-6}
STRUCTO-LITE Plaster	4.8×10^{-6}
Vermiculite Gypsum Plaster (sanded 100:2)	3.8×10^{-6}

Thermal Resistance Coefficients of Building and Insulating Materials(1)

thickness		product	density		resistance	
in	mm		lb/ft³	kg/m³	In·ft²·°F/Btu	K·m²/W
2-2¾	50.8- 69.9	Mineral Fiber Insulation			7.00	1.23
3-3½	76.2- 88.9	Mineral Fiber Insulation			11.00	1.94
5¼-6½	133.4-165.1	Mineral Fiber Insulation			19.00	3.35
1	25.4	Extruded Polystyrene Insulation	2.2	35.2	5.00	0.88
½	12.7	SHEETROCK Brand Gypsum Panels	43	690.2	0.45	0.08
⅝	15.9	SHEETROCK Brand Gypsum Panels	43	690.2	0.56	0.10
½	12.7	SHEETROCK Brand FIRECODE "C" Panels	50	800.9	0.45	0.08
⅝	15.9	SHEETROCK Brand FIRECODE and FIRECODE "C" Panels	50	800.9	0.56	0.10
⅜	9.5	ROCKLATH Plaster Base	50	800.9	0.32	0.06
½	12.7	USG Gypsum Sheathing	50	800.9	0.45	0.08
½	12.7	Sanded Plaster	105	1681.9	0.09	0.02
½	12.7	Plaster with Lightweight Aggregate	45	720.8	0.32	0.06
4	101.6	Common Brick	120	1922.2	0.80	0.14
4	101.6	Face Brick	130	2082.4	0.44	0.08
1	25.4	Portland Cement Stucco with Sand Aggregate	116	1858.1	0.20	0.04
4	101.6	Concrete Block, 3-oval Core, Cinder Aggregate			1.11	0.20
8	203.2	Concrete Block, 3-oval Core, Cinder Aggregate			1.72	0.30
12	304.8	Concrete Block, 3-oval Core, Cinder Aggregate			1.89	0.33
—	—	Vapor-Permeable Felt			0.06	0.01
—	—	Vapor-Retarder Plastic Film			Negl.	—
1	25.4	Stone			0.08	0.01
1×8	25.4-203.2	Wood Drop Siding			0.79	0.14
¾×10	19.1-254.0	Beveled Wood Siding			1.05	0.18
¾-3½	19.1- 88.9	Plain Air Space, non-reflective(2)			0.92	0.17
¾-3½	19.1- 88.9	Plain Air Space, reflective(3)			2.59	0.46

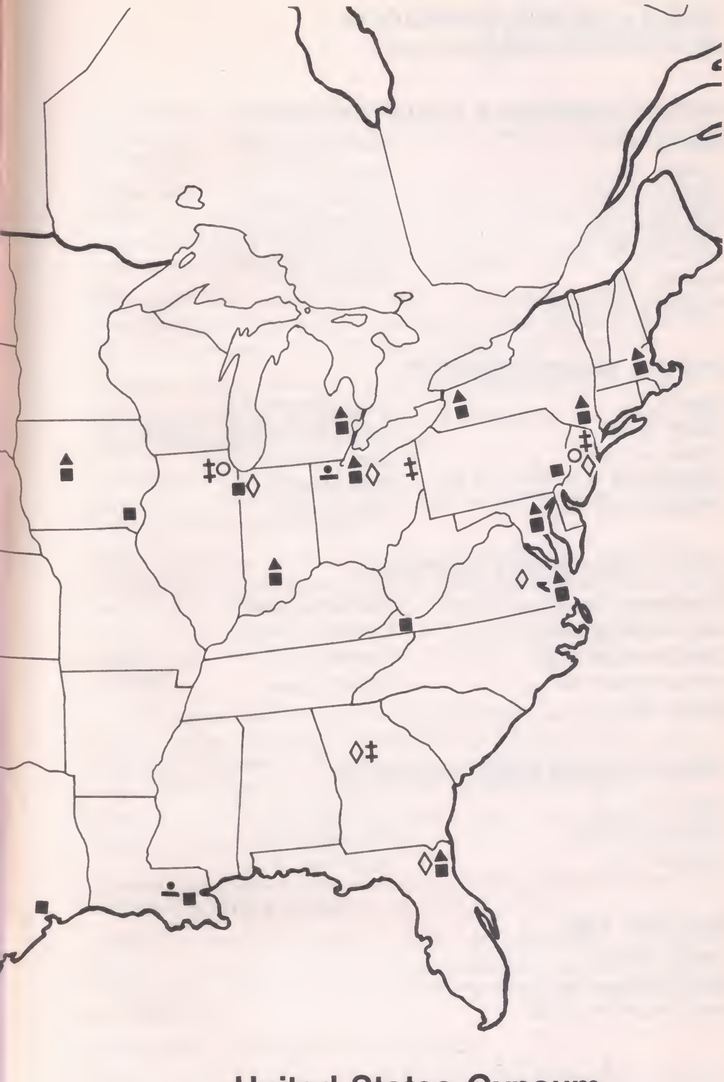
(1)All factors based on data from 1981 ASHRAE Handbook of Fundamentals. Factors at 75°F, mean temperature.
(2)Conditions: heat flow horizontal; mean temperature 50°F. Temperature differential 30°F; E (emissivity) 0.82.
(3)Conditions: heat flow horizontal; mean temperature 50°F. Temperature differential 30°F; E (emissivity) 0.05.

U.S.G. literature services

Complete technical data on U.S.G. products and systems can be found in the U.S.G. Architectural Technical Literature series. Those folders applying to drywall and plaster construction are listed below, together with their location in Sweet's General Building File. Copies of all folders, including those not contained in Sweet's files, are available through U.S.G. sales offices.

folder no. & description		Sweet's sec. no.
Steel Framing		
SA-510	Steel Framing Systems	5.3
Insulation		
SA-705	Building & Acoustical Insulation	7.14
SA-707	THERMAFIBER Fire Safety Systems	7.14
SA-710	FOAMULAR Extruded Polystyrene Insulation	7.14
Curtain Walls, Doors & Frames		
SA-805	Exterior Curtain Walls	8.14
Lath, Plaster		
SA-912	Steel Framed Veneer Plaster Partitions/ Ceilings	9.5
SA-913	Wood-Framed Veneer Finish Partitions/Ceilings	
SA-915	Steel-Framed Gypsum Lath Partitions	9.5
SA-917	Plasters, Bases & Accessories	9.5
Gypsum Drywall		
SA-922	Cavity Shaft Wall Partitions	9.5
SA-923	Steel-Framed Gypsum Drywall Partitions/ Ceilings	9.5
SA-924	Wood-Framed Gypsum Drywall Partitions/Ceilings	
SA-925	Area Separation Walls	9.5
SA-927	Gypsum Panels & Accessories	9.5
SA-928	TEXTONE Vinyl-Faced Gypsum Panels	9.12
Paints, Coatings		
SA-933	Texture and Paint Products	9.5
Demountable Partitions		
SA-1020	ULTRAWALL Movable	10.1


LEGEND
Gypsum Plasters
Gypsum Board
Jt. Treatment & Textures
Steel Accessories
Adhesives
Building Lime



United States Gypsum
Plant Locations

U.S.G. plant locations
(Gypsum Products and Accessories)

GYPSUM PLASTERS & BOARD PRODUCTS

Detroit, Mich.
Shoals, Inc.
Gypsum, Ohio
Baltimore, Md.
Jacksonville, Fla.
Norfolk, Va.
Plaster City, Calif.
Fort Dodge, Ia.
Southard, Okla.
Boston, Mass.
Stony Point, N. Y.
Sweetwater, Tex.
Empire, Nev.

GYPSUM BOARD PRODUCTS

Sperry, Ia.
Heath, Mont.
Plasterco, Va.
Oakfield, N. Y.
Philadelphia, Pa.
Galena Park, Tex.
Santa Fe Springs, Calif.
East Chicago, Ind.
New Orleans, La.
Sigurd, Utah

JOINT TREATMENT & TEXTURES

Chamblee, Ga.
Port Reading, N. J.
East Chicago, Ind.
Jacksonville, Fla.
Dallas, Tex.
Torrance, Calif.
Gypsum, Ohio
Norfolk, Va.
Sigurd, Utah

CONSTRUCTION STEEL PRODUCTS

Kearny, N. J.
Torrance, Calif.
Morrow, Ga.
Franklin Park, Ill.
Warren, Ohio
Mansfield, Tex.

BUILDING LIME

Genoa, Ohio
New Orleans, La.
New Braunfels, Tex.

glossary

Acoustics—A science dealing with the production, control, transmission, reception, and effects of sound, and the process of hearing.

Aggregate—The sand, gravel, crushed stone or other material which is a main constituent of portland cement concrete and aggregated gypsum plaster. Also polystyrene, perlite and vermiculite particles used in texture finishes.

AIA—American Insurance Assn., a nonprofit organization of insurance companies and successor to the National Board of Fire Underwriters. Also, American Institute of Architects.

Airborne Sound—Sound traveling through the medium of air.

Anchor—A metal securing device embedded or driven into masonry, concrete, steel or wood.

Anchor Bolt—A heavy, threaded bolt embedded in the foundation to secure sill to foundation wall or bottom plate of exterior wall to concrete floor slab.

ANSI—American National Standards Institute, a nonprofit national technical association which publishes standards covering definitions, test methods, recommended practices and specifications of materials. Formerly American Standards Assn. (ASA), and United States of America Standards Institute (USASI).

Area Separation Wall—A fire-rated partition, usually with a 2- to 4-hour rating, designed to prevent the spread of fire from an adjoining occupancy; also usually provides good sound attenuation. Extends from foundation to or through the roof.

ASA—Formerly American Standards Assn., now American National Standards Institute (ANSI).

Askew—Crooked, distorted, out of position such as a warped or misapplied timber or stud.

ASTM—American Society for Testing and Materials, a nonprofit, national technical society which publishes definitions, standards, test methods, recommended practices and specifications for materials.

Attenuation—Reduction in sound level.

Backup Strips—Pieces of wood nailed at the ceiling-sidewall corner to provide fastening for ends of plaster base or gypsum panels.

Balloon Frame—A method of framing outside walls in which studs extend the full length or height of the wall.

Bar Joist—An open-web, flat truss structural member used to support floor or roof structure. Web section is made from bar or rod stock, and chords are usually fabricated from "T" or angle sections.

Batten—A narrow strip of wood, plastic or metal used to conceal an open joint.

BCMC—Board for the Coordination of Model Codes; part of CABO.

Beam—A horizontal, load-bearing member.

Bearing—A support section upon which something rests, such as the point on bearing walls where the weight of the floor or roof above bears.

Bed—To set firmly and permanently in place.

Bending—The bowing of a member that results when a load or loads are applied at a distance from a support.

Board Foot (Bd. Ft.)—The volume of a piece of wood, 1″ · 1 ft. × 1 ft. nom. All lumber is sold by the board-foot measure.

BOCA—Building Officials Conference of America, a nonprofit organization which publishes the Basic/National Building Code.

Brick Veneer—A brick facing applied to a wall to give it the appearance of solid-brick construction; bricks are fastened to backup structure with metal ties embedded in mortar joints.

Bridging—Members attached between floor joists to distribute concentrated loads over more than one joist and prevent rotation. Solid bridging consists of joist-depth lumber installed perpendicular to, and between the joists. Cross-bridging consists of pairs of braces set in an "X" form between joists.

CABO—Council of American Building Officials Association, made up of representatives from three model codes. Issues National Research Board (NRB) research reports.

Camber—Curvature built into a beam or truss to compensate for loads that will be encountered when in place and full dead load is applied. The crown is placed upward. Insufficient camber will result in unwanted deflection when loaded.

Cant Beam—A beam with edges chamfered or beveled.

Cant Strip—A triangular section laid at the intersection of two surfaces to ease or eliminate the effect of a sharp angle or projection.

Carrying Channel—Main supporting member of a suspended ceiling system to which furring members or channels attach.

Casement—A glazed sash or frame hung to open like a door.

Casing—In foundations, a tube of wood or steel, usually circular, used to retain the walls of a deep, narrow excavation. In carpentry, the trim around windows, doors, columns or piers.

Chalk Line—A straight working line made by snapping a chalked cord stretched between two points, transferring the chalk to the work surface.

Coefficient of Thermal Conductance (C)—The amount of heat (in Btu) that will pass through a *specific thickness* of a material (either homogeneous or heterogeneous) per hr., per sq. ft., per

°F., measured as the temperature difference between surfaces.

The "C" value of a homogeneous material is equal to the "k" value divided by the thickness of the material.

$$C = \frac{k}{t} \text{ where } t = \text{thickness of the material in inches}$$

It is impractical to determine a "k" value for some materials such as building paper or those only used or formed as a thin membrane, so only "C" values are given for them.

Coefficient of Thermal Conductivity (k)—A convenient factor that represents the amount of heat (in Btu) that will pass by conduction through a homogeneous material, per hr., per sq. ft., per *in. thickness,* per °F., measured as the temperature difference between the two surfaces of the material.

Coefficient of Heat Transmission (U)—The total amount of heat that will pass through a combination of materials, including the air spaces and both surface air films. It is expressed in Btu per hr., per sq. ft., per °F. temperature difference between inside and outside air (beyond the surface air films). "U" values are often used to represent wall and ceiling assemblies, floors and windows.

It should be noted that "k" and "C" values *cannot* simply be added to obtain "U" values. "U" can only be obtained by adding the thermal resistance (reciprocal of "C") of the individual items and dividing the total into 1.

Coefficient of Hygrometric Expansion—See Hygrometric Expansion.

Coefficient of Thermal Expansion—See Thermal Expansion.

Column—A vertical, load-bearing member.

Compression—A force that presses the particles of a body closer together.

Compressive Strength—Measures maximum resistance of a material to axial crushing load, expressed as force per unit cross-sectional area.

Concrete Footing—The generally wide, lower part of a foundation wall which spreads the weight of the building over a larger area. Its width and thickness vary according to the weight of the building and the type of soil on which the building is erected.

Conduction, Thermal—The transfer of heat from one part of a body to another part of that body, or to another body in close contact, without any movement of the bodies involved. The hot handle of a skillet is an example. The heat travels from the bottom of the skillet to the handle by conduction.

Convection—The process of heat carried from one point to another by the movement of a liquid or a gas (i.e., air). Natural convection is caused by the expansion of the liquid or gas when heated. The expansion reduces the density of the medium, causing it to rise above the cooler, more dense portions of the medium.

Gravity heating systems are examples of the profitable use of

natural convection. The air, heated by the furnace, becomes less dense (consequently lighter) and rises, distributing heat to the various areas of the house without any type of blower. When a blower is used, the heat transfer method is called "forced convection".

Corner Brace—A structural framing member used to resist diagonal loads which cause racking of walls and panels due to wind and seismic forces. May consist of a panel or diaphragm, or diagonal flat strap or rod. Bracing must function in both lateral directions. If brace only performs in tension, two diagonal members must be employed in opposing directions (in tension).

Corner Post—A timber or other member forming the corner of a frame. May be solid or built-up as a multi-piece member.

Cripple—A short stud such as that used between a door or window header and the top plate.

Curtain Wall—An exterior wall of a building that is supported by the structure and carries no part of the vertical load except its own (and sometimes not all of that). Curtain walls must be designed to withstand wind loads and transmit them to the structure.

Cycle (acoustic)—One full repetition of a motion sequence during periodic vibration. Movement from zero to +1 back to zero to −1 back to zero. Frequency of vibration is expressed in cycles per second (see Hertz).

Dead Load—The load on a building element contributed by the weight of the building materials.

Decibel (db)—A unit adopted for convenience in representing vastly different sound pressures. It is 20 times the logarithm to the base 10 of the ratio of the sound pressure to a reference pressure of 20 micropascals. This reference pressure is considered the lowest value at 1000 Hz that the ear can detect. For every 10 db increase or decrease in sound pressure level, a sound is generally judged to be about twice or half as loud as before the change.

Decoupling—The separation of elements to reduce or eliminate the transfer of sound, heat or physical loads from one element to the other.

Deflection—The displacement that occurs when a load is applied to a member or assembly. The dead load of the member or assembly itself causes some deflection. Under applied loads maximum deflection occurs at mid-height in partitions and walls and at mid-span in ceilings.

Deflection Limitation—Maximum allowable deflection is dictated by code or good practice. Often expressed as ratio of span (L) divided by criterion factor (120, 240, 360). For example, in a 10-ft. or 120″ high wall, allowable deflection under L/240 criterion equals 120/240 or ½″ maximum.

Selection of limiting heights and spans are based on allowable deflection as follows: *(a)* L/240 for gypsum panel surfaces, veneer finish surfaces, and areas to receive adhesively applied

ceramic tile, *(b)* L/360 for conventional lath and plaster surfaces, *(c)* mechanically attached marble or heavy stone should support its own weight from the floor or be separately supported. While some building codes permit L/120 allowable deflection with 5 lb./ft.^{2} uniform load for interior partitions with flexible finishes, this large deflection may be esthetically unacceptable.

Deformation—The change in shape of a body brought about by the application of a force. Deformation is proportional to the force within the elastic limits of the material.

Design Load—The combination weight (dead load) or other forces (live loads) for which a building or part of a building is designed. Based on the worst possible combination of loads.

Door Buck—The structural element of a door opening. May be the same element as the frame if frame is structural, as in the case of heavy steel frames.

Double-Hung Window—Window sash that slide vertically and are offset in a double track.

Drip—An interruption or offset in an exterior horizontal surface, such as a soffit, immediately adjacent to the fascia. Designed to prevent the migration of water back along the surface.

Drywall—A generic term for interior surfacing material, such as gypsum panels or plywood paneling, applied to framing using dry construction methods, i.e.: mechanical fasteners or adhesive. See SHEETROCK Brand Gypsum Panels.

Extrapolate—To project tested values, assuming a continuity of an established pattern, to obtain values beyond the limit of the test results.

Factor of Safety—The ratio of the ultimate unit stress to the working or allowable stress.

Fascia Board—A board fastened to the ends of the rafters or joists forming part of a cornice.

Fast Track—A method that telescopes or overlaps the traditional design-construction process. Overlapping phases as opposed to sequential phases is the keynote of the concept.

Fatigue—A condition of material under stress that has lost, to some degree, its power of resistance as a result of repeated application of stress, particularly if stress reversals occur.

Fire Endurance—A measure of the elapsed time during which an assembly continues to exhibit fire resistance under specified conditions of test and performance. As applied to elements of buildings, it shall be measured by the methods and to the criteria defined in ASTM Methods E119, Fire Tests of Building Construction and Materials ASTM Methods E152, Fire Tests of Door Assemblies, or ASTM Methods E163, Fire Tests of Window Assemblies.

Fireproof—The use of this term in reference to buildings is discouraged because few, if any, building materials can withstand extreme heat for an extended time without some effect. The term "fire-resistive" or "resistant" is more descriptive.

Fire Resistance—A relative term, used with a numerical rating or modifying adjective to indicate the extent to which a material or structure resists the effect of fire.

Fire-Resistive—Refers to properties or designs to resist the effects of any fire to which a material or structure may be expected to be subjected.

Fire-Retardant—Denotes a substantially lower degree of fire resistance than "fire-resistive". This term is often used to describe materials that are combustible but have been treated to retard ignition or spread of fire under the conditions for which they were designed.

Fire Stop—An obstruction in a cavity designed to resist the passage of flame and hot gases sufficient to ignite cotton waste.

Fire Wall—A fire-resistant partition extending to or through the roof of a building to retard the spread of fire. Also see Area Separation Wall.

Flame Spread—An index of the capacity of a material to spread fire under test conditions as defined by ASTM Standard E84. Materials are rated by comparison with the flame-spread index of red oak flooring assigned a value of 100 and cement-asbestos board assigned a value of 0.

Flammable—The capability of a combustible material to ignite easily, burn intensely or have a rapid rate of flame spread.

Flanking Paths—Paths by which sound travels around an element that is intended to impede it, usually some structural component which is continuous between rooms and rigid enough to transmit the sound. For example, a partition separating two rooms can be "flanked" by the floor, ceiling or walls surrounding the partition if they run uninterrupted from one room to the other. Ducts, conduits, openings, structural elements, rigid ties, etc., can be sound flanking paths. The acoustic effect of sound flanking paths is dependent on many factors.

Flashing—Strips of metal or waterproof material used to make joints waterproof as in joining of curtain wall panels.

Footing—The lower extremity of a foundation or load-bearing member that transmits the load to the load-bearing substrate.

Force—The amount of applied energy to cause motion, deformation or displacement and stress in a body.

Foundation—A member that transfers the weight of the building and occupants to the earth.

Frequency (sound)—The number of complete vibrations or cycles or periodic motion per unit of time. The units of measure of sound frequency is Hertz (Hz), named for Heinrich H. Hertz. One Hertz is equal to one cycle per second.

Furring—A member or means of supporting a finished surfacing material away from the structural wall or framing. Used to level uneven or damaged surfaces, or to provide a space between substrates.

Gable—The uppermost portion of the end wall of a building which comes to a triangular point under a sloping roof.

Girder—A beam, especially a long, heavy one; the main beam supporting floor joists.

Gusset—A wood or metal plate riveted, bolted, glued or pressed (wood trusses) over joints to transfer stresses between the members.

Header—The horizontal framing member across the ends of the joists. Also the member over a door or window opening in a wall.

Heat—A form of energy, thought to be characterized by the rate of vibration of the molecules of a substance. The hotter the substance, the faster the molecules vibrate. On the other hand, when there is no heat present, it is thought the molecules will be at rest, which theoretically occurs at absolute zero, 459.7°F. (273.15°C. or 0.0°K).

Heat Quantity (Btu)—The common unit of measure of quantity of heat is the British Thermal Unit (Btu). One Btu is the amount of heat required to raise one pound of water from 63° to 64°F. (1 Btu = 1055.06 J). This is about the amount of heat given off by one wooden match. A pound of coal can produce 13,000 Btu.

Heat Transfer—Heat will always flow toward a substance of lower temperature until the temperatures of the two substances are equal. It travels by one or more of three methods: conduction, convection or radiation.

Heel of Rafter—The seat cut in a rafter that rests on the wall plate.

Honeycomb—Any substance having cells suggesting a mass of cells like those built by the honeybee. Some hollow-core doors use the honeycomb principle in their construction.

HVAC—Heating, ventilating and air conditioning.

Hygrometric Expansion—All materials, and particularly those of organic origin, expand and contract in relation to their moisture content, which varies with environment. The Hygrometric Coefficient of Expansion is expressed in "Inches Per Inch Per Percent Of Relative Humidity". Example: gypsum board has a coefficient of 7.2×10^{-6} in. per in. per %rh. This means that with an increase in relative humidity of from 10% to 50%, a gypsum board wall 300 ft. long will have a linear expansion of 1.0368″ or $1\frac{1}{32}$″.

ICBO—International Conference of Building Officials, a non-profit organization which publishes the Uniform Building Code.

Impact Insulation Class (IIC)—A single-number rating used to compare and evaluate the performance of floor-ceiling constructions in isolating impact noise. The advantages of this rating system are positive values and the correlation with STC values —both providing approximately equal isolation at a particular value. The IIC rating is used by Federal housing agencies for specifying minimum sound-control performance of assemblies in residential construction.

Impact Noise Rating (INR)—A now obsolete rating system for floor-ceiling construction in isolating impact noise. INR ratings can be converted to approximate IIC ratings by adding 51 points; however, a variation of 1 or 2 points may occur.

Incombustible—See Noncombustible.

Insulation (Thermal)—Any material that measurably retards heat transfer. There is a wide variation in the insulating value of different materials. A material having a low density (weight/volume) will usually be a good thermal insulator.

Interpolate—To estimate untested values which fall between tested values.

Jamb—One of the finished upright sides of a door or window frame.

Joist—A small beam that supports a part of the floor, ceiling or roof of a building.

Joist Hanger—A metal shape formed for hanging on the main beam to provide support for the end of a joist.

Kiln-Dried Lumber—Lumber which has been dried and seasoned with carefully controlled heat in a kiln.

Label Service (UL)—A program allowing a manufacturer to place Underwriters Laboratories, Inc. labels on his products that have met UL requirements. A UL representative visits the manufacturing location to obtain samples of the products for testing by UL. In some cases, samples are also purchased on the open market for testing. The public is thereby assured that products bearing the UL label continually meet UL specifications.

Leaks (Sound)—Small openings for electrical boxes and plumbing, cracks around doors, loose-fitting trim and closures all create leaks that allow sound to pass through, reducing the effectiveness of a sound wall, floor or ceiling system.

Ledger Strip—A strip fastened to the bottom edge of a flush girder to help support the floor joists.

Life-Cycle Costing—Selection of the most economical material and systems based on initial costs, maintenance costs and operating costs for the life of the building.

Limiting Height—Maximum height for design and construction of a partition or wall without exceeding the structural capacity or allowable deflection under given design loads.

Lintel—A horizontal member spanning over an opening such as a window or door. Also referred to as a Header.

Live Load—That part of the total load on structural members that is not a permanent part of the structure. It may be variable, as in the case of loads contributed by the occupancy, and wind and snow loads.

Load—A force provided by weight or mass (gravitational), external or environmental sources such as wind, water and temperature, or other sources of energy.

Loudness—The subjective response to sound pressure, but not linearly related thereto. A sound with twice the pressure is not twice as loud.

Louver—An opening with slanted fins (to keep out rain and snow) used to ventilate attics, crawl spaces and wall openings.

Mass—The property of a body that resists acceleration and produces the effect of inertia. The weight of a body is the result of the pull of gravity on the body's mass.

Metric Terms—The Metric (SI) Units shown as equivalents in this handbook are from the International System of Units in use throughout the world, as established by the General Conference of Weights and Measures in 1960. Their use here complies with the Metric Conversion Act of 1975, which committed the United States to a coordinated voluntary conversion to the metric system of measurement.

The following SI Units and conversion factors are applicable to subjects covered in this handbook. For additional information, refer to ASTM E380-76 "Standard for Metric Practice".

Basic Units

quantity	metric (SI)		U.S.A. equivalent (nom.)(1)
	unit	symbol	
Length	millimeter meter	mm m	0.039 in. 3.281 ft. 1.094 yd.
Area	meter	m^2	10.763 $ft.^2$ 1.195 $yd.^2$
Volume	meter	m^3	35.314 $ft.^3$ 1.307 $yd.^3$
Volume (Fluid)	liter	L	33.815 oz. 0.264 gal.
Mass (Weight)	gram kilogram ton	g kg t	0.035 oz. 2.205 lb. 2,204.600 lb. 1.102 tons
Force	newton	N	0.225 lbf.
Temperature (Interval)	kelvin degree celsius	K °C	1.8 °F 1.8 °F
Temperature	celsius	°C	(°F-32)5/9
Thermal Resistance		$\frac{K \cdot m^2}{W}$	$\frac{5.679\ ft^2 \cdot hr \cdot °F}{Btu}$
Heat Transfer	watt	W	3.412 Btu/hr.
Pressure	kilopascal pascal	kPa Pa	0.145 $lb./in.^2$ (psi) 20.890 $lb./ft.^2$ (psf)

(1)To convert U.S.A. Units to SI Units, divide by U.S.A. equivalent.

Prefixes (Order of Magnitude)

prefix	symbol	factor
mega	M	1 000 000 = 10^{+6}
kilo	k	1 000 = 10^{+3}
centi[1]	c	0.01 = 10^{-2}
milli	m	0.001 = 10^{-3}
micro	μ (mu)	0.000 001 = 10^{-6}

[1]Limited use only.

Miter—The joint formed by two pieces of material cut to meet at an angle.

Model Code—A building code, written and published by a building-official association, available to states, counties and municipalities for adoption (for a fee) in lieu of their own, i.e.: ICBO, SBCC, BOCA.

Module—(1) In architecture, a selected unit of measure used as a basis for building layout; (2) In industrialized housing, a three-dimensional section of a building, factory-built, shipped as a unit, and interconnected with other modules to form the complete building. Single-family units factory-built in two halves are usually referred to as "sectionals".

Modulus of Elasticity (E)—The ratio between stress and unit deformation, a measure of the stiffness of a material.

Moment of Inertia (I)—A calculated numerical relationship (expressed in inches^4) of the resistance to bending of a member, a function of the cross-sectional shape and size. A measure of the stiffness of a member based on its shape. Larger moments of inertia indicate greater resistance to bending.

Moulding (also Molding)—A narrow decorative strip applied to a surface.

Mullion—A vertical bar or division in a window frame separating two or more panes.

Muntin—A horizontal bar or division in a window frame separating multiple panes or lights.

NBFU—National Board of Fire Underwriters, now merged into the American Insurance Assn.

NCSBCS—National Conference of States on Building Codes and Standards, a non-profit organization formed to increase interstate cooperation and coordinate intergovernmental reforms of building codes.

Neutral Axis—The plane through a member (at the geometric center of the section in symmetrical members) where the fibers are neither under tensile nor compressive stress.

NFiPA—National Fire Protection Assn., an international technical society which disseminates fire prevention, fighting and protection information. NFiPA technical standards include the National Electrical Code which is widely adopted.

Noise Reduction Coefficient (NRC)—The arithmetic average of the sound absorption coefficients at 250, 500, 1000, and 2000 Hz.

Nominal—A term indicating that the sull measurement is not used; usually slightly less than the full net measurement, as with 2″×4″ studs which have an actual size when dry of 1½″×3½″.

Noncombustible—Definition excerpted from the ICBO Uniform Building Code (also see ASTM E176).

1. Material of which no part will ignite and burn when subjected to fire.

2. Material having a structural base of noncombustible material as defined, with a surface not over ⅛″ thick which has a flame spread rating of 50 or less.

The term does not apply to surface finish materials.

Octave—A portion of a frequency scale whose upper limiting frequency is a factor of two higher than the lower limiting frequency. One octave lies between 100 Hz and 200 Hz and 400 Hz, etc. Two octaves lie between 400 Hz and 1600 Hz, etc.

OSU—The Ohio State University, an independent fire-testing laboratory.

Parapet Wall—An extension of an exterior wall above and/or through the roof surface.

Penny (d)—A suffix designating the size of nails, such as 6d (penny) nail, originally indicating the price, in English pence, per 100 nails. Does not designate a constant length or size, and will vary by type (i.e., common and box nails).

Performance Specification—States how a building element must perform as opposed to describing equipment, products or systems by name.

Pilaster—A projecting, square column forming part of a wall.

Pillar—A column supporting a structure.

Pitch of Roof—The slope of the surface, generally expressed in inches of vertical rise per 12″ horizontal distance, such as "4 in 12 pitch".

Plate—"Top" plate is the horizontal member fastened to the top of the studs or wall on which the rafters, joists or trusses rest; "sole" plate is positioned at bottom of studs or wall.

Platform—A floor surface raised above the ground or floor level.

Platform Framing—A technique of framing where walls can be built and tilted-up on a platform floor, and in multi-story construction are erected sequentially from one platform to another. Also known as "Western" framing.

Plenum—A chamber in which the pressure of the air is higher (as in a forced-air furnace system) than that of the air surrounding it.

Portland Cement—Hydraulic cement produced by pulverizing clinker consisting essentially of hydraulic calcium silicates, usually containing one or more forms of calcium sulfate as an interground addition.

Prescription Specification—Traditional procedure used on building projects to describe by name products, equipment or systems to be used.

Purlin—A horizontal member in a roof supporting common rafters, such as at the break in a gambrel roof; also, horizontal structural members perpendicular to main beams in a flat roof.

Racking—The forcing out of plumb of structural components, usually by wind, seismic stress, or thermal expansion or contraction.

Radiation—The transfer of heat energy through space by wave motion. While the radiant energy of heat is being transmitted through space, no heat is present until this energy strikes and is absorbed by an object. Not all of the radiant heat energy is absorbed; some is reflected to travel in a new direction until it strikes another object. The amount reflected depends on the nature of the surface that the energy strikes. This fact explains the principle of insulating foil and other similar products that depend on reflection of radiant heat for their insulating value.

Radiant heat travels in straight lines in all directions at about the speed of light. In radiant heating systems, heat is often radiated down from the ceiling. As it strikes objects in the room, some is absorbed, and some is reflected to other objects. The heat which is absorbed warms the object, and it, in turn, warms the surrounding air by conduction. This warmed air sets up gentle convection currents which circulate throughout the room.

Rafter—That member forming the slanting frame of a roof or top chord of a truss; also known as hip, jack or valley rafters depending on their location and use.

Rafter Tail—That part of a rafter which extends beyond the wall plate—the overhang.

Reflected Heat—See Radiation.

Reflected Sound—Sound that has struck a surface and "bounced off". Sound reflects at the same angle as light reflects in a mirror; the angle of incidence equals the angle of reflection.

Large curved surfaces tend to focus (concave) or diffuse (convex) the sound when reflected. However, when the radius of the reflecting surface is less than the wavelength of the sound, this does not hold true. Thus, a rough textured surface has little effect on diffusion of sound.

Reflective Insulation—A material that reflects, and thus retards the flow of radiant heat. The most common type of reflective insulation is aluminum foil. It reflects above 95% of the radiant heat that strikes it and emits very little radiant heat itself.

Aluminum will not retard heat traveling by conduction when it is in direct contact with a solid material. But, since ⅔ of the heat flowing across a dead air space of ¾″ or more is radiant heat, aluminum placed on either face of an air space is a very effective insulator, equivalent to about ¾″ of mineral wool.

Reflective insulations are affected by the direction of the flow of heat to some extent. If installed horizontally, as in a ceiling, upward convection currents will carry heat away from the insulation. Consequently, reflective insulation in a roof or ceiling is more effective in controlling summer heat transfer (downward) than winter heat transfer (upward). Convection is not appreciable in vertical walls; hence, the effectiveness of the reflective insulation is little altered.

Reverberation—The persistence of sound after the source stops. When one hears the 10th, 20th, 50th, 100th, etc., reflection of a sound, one hears reverberation.

Reverberation Time—Essentially the number of seconds it takes a loud sound to decay to inaudibility after the source stops. Strictly, the time required for a sound to decay 60 db in level.

Ridge—The peak of a roof where the roof surfaces meet at an angle. Also may refer to the framing member that runs along the ridge and supports the rafters.

Rise—A measurement in height of an object; the amount it rises. The converse is "fall".

Riser—The vertical face of a step supporting the tread in a staircase.

Rough Framing—The structural framing of a framed structure.

Sabin—A measure of sound absorption of a surface, equivalent to 1 sq. ft. of a perfectly absorptive surface.

Safing—A fire-stop material in the space between floor slab and curtain wall in multi-story construction.

Safing Off—Installation of fire safety insulation around floor perimeters between floor slab and spandrel panels and in "poke-thru" openings in walls and floors. Insulation helps retain integrity of fire resistance ratings.

SBCC—Southern Building Code Congress International, a non-profit organization which publishes the Standard Building Code.

Scab—A small piece or block of wood that bridges several members or provides a connection or fastening between them.

Section Modulus (S)—A numerical relationship, expressed in inches^3, of the resistance to stress of a member. It is equal to the moment of inertia divided by the perpendicular distance from the neutral axis to the extremity of the member.

Shaft Wall—The fire-resistant wall that isolates the elevator and/or stairwell core in high-rise construction. This wall must withstand the fluctuating (positive and negative) air-pressure loads created by elevators.

Shear—A force that tends to slide or rupture one part of a body from another part of the body or from attached objects.

Sheathing—Plywood, gypsum, wood fiber, expanded plastic or composition boards encasing walls, ceilings, floors and roofs of framed buildings. May be structural or non-structural, thermal-insulating or non-insulating, fire-resistant or combustible.

SHEETROCK—There is only one SHEETROCK Brand Gypsum Panel—the gypsum panel for interior wall and ceiling surfaces developed and improved by United States Gypsum.

Shoring—A temporary member placed to support part of a building during construction, repair or alteration; also, to support the walls of an excavation.

Sill—Horizontal member at the bottom of door or window frames to provide support and closure.

Sill Plate—Horizontal member laid directly on a foundation on which the framework of a building is erected.

Slab—A flat (although sometimes ribbed on the underside) reinforced concrete element of a building which provides the base for the floor or roofing materials.

Soffit—The undersurface of a projection or opening; the bottom of a cornice between the fascia board and the outside of the building; the underside of a stair, floor or lintel.

Sole Plate—See Plate.

Sound Absorption—The conversion of acoustic or sound energy to another form of energy, usually heat.

Sound Insulation, Isolation—The use of building materials or constructions which will reduce or resist the transmission of sound.

Sound Intensity—The amount of sound power per unit area.

Sound Pressure Level (SPL)—Expressed in decibels, the SPL is 20 times the logarithm to the base 10 of the ratio of the pressure of sound to a reference pressure of 20 micropascals.

Sound Transmission Class (STC)—A rating for evaluating the effectiveness of a construction in isolating airborne sound transmission. Higher numbers indicate more effectiveness.

Span—Distance between supports, usually of a beam or joist.

Spandrel Beam—The horizontal member, spanning between exterior columns, that supports the floor or roof.

Spandrel Wall—The exterior wall panel, usually between columns, that extends from the window opening on one floor to one on the next floor.

Speed of Sound—The speed of sound in air varies with atmospheric pressure and temperature, but is the same at all frequencies. For most architectural work, the speed of sound should be taken as 1,130 ft./second.

Stile—The vertical outside member in a piece of framed work, as a door or sash.

Stirrup—A hanger to support the end of the joist at the beam.

Stop—A strip of wood fastened to the jambs and head of a door or window frame against which the door or window closes.

Strain—The deformation in a body that results from stress.

Stress—The resistance of a body to an outside force that tends to deform the body by tension, compression of shear.

Stringer—A heavy horizontal timber supporting other members of the frame in a wood or brick structure; a support also for steps.

Structure-Borne Sound—Sound energy imparted directly to and transmitted by solid materials, such as building structures.

Strut—A slender structural element that resists compressive forces acting lengthwise.

Stud—A vertical load- or non-load-bearing framing member.

Subfloor—The rough or structural floor placed directly on the floor joists or beams, to which the finished floor is applied. As with resilient flooring, an underlayment may be required between subfloor and finished floor.

Substrate—The underlying material to which a finish is applied, or by which it is supported.

Surface Burning Characteristic—A rating of interior and surface finish material providing indices for surface burning, fuel contributed and smoke developed based on testing conducted according to ASTM Standard E84.

Temperature—A measurement of the intensity (not quantity) of heat. The Fahrenheit (°F) scale places the freezing point of water at 32° and the boiling point at 212°. The Centigrade or Celsius (°C) scale, used by most countries and in scientific work, places the freezing point of water at 0° and the boiling point at 100°. On the Kelvin (K) scale, the unit of measurement equals the Celsius degree and measurement begins at absolute zero 0° (−273°C).

Tensile Strength—The maximum tensile stress that can be developed in a given material under axial tensile loading. Also the measure of a material's ability to withstand stretching.

Tension—A force that tends to pull the particles of a body apart.

Thermal Expansion—All materials expand and contract to some extent with changes in temperature. The Thermal Coefficient of Linear Expansion is expressed in "Inches Per Inch Per Degree Fahrenheit". Example: gypsum board has a coefficient of 9.0×10^{-6} in. per in. per °F. This means that with an increase in temperature of 50°, a gypsum board wall 100 ft. in length will have a linear expansion of .54″ or in excess of ½″. The expansion characteristics of some other building materials are more pronounced; a 50° temperature increase would produce expansion in a 100-ft. length of approx. ¾″ in aluminum, ⅜″ in steel and ½″ in concrete.

Thermal Resistance (R)—The resistance of a material or assembly to the flow of heat. It is the reciprocal of the heat transfer coefficient

$$\left(\frac{1}{C}, \text{ or } \frac{1}{U}\right).$$

For insulating purposes, low "C", and "U" values and high "R" values are the most desirable.

Threshold—A raised member at the floor within the door jamb. Its purpose is to provide a divider between dissimilar flooring materials, or to serve as a thermal, sound or water barrier.

Time-Temperature Curve—The rate-of-rise of temperature in a fire-testing furnace.

Toenail—A method of fastening two boards together as in a "T" by driving nails into the board that forms the stem of the "T" at an angle so they enter the other board and cross each other.

Tongue-and-Groove Joint—A joint where the projection or "tongue" of one member engages the mating groove of the adjacent member to minimize relative deflection and air infiltration; widely used in sheathing, flooring and paneling. Tongues may be in "V", rounded or square shapes.

Transmission Loss (TL)—Esssentially the amount, in decibels, by which sound power is attenuated by passing from one side of a structure to the other. TL is independent of the rooms on each side of the structure and theoretically independent of the area and edge conditions of the structure.

Tread—The horizontal plane or surface of a stair step.

Trimmer—The double joists or rafters framing the opening of a stairway well, dormer opening, etc.

Truss—An open, lightweight framework of members, usually designed to replace a large beam where spans are great.

U of C—University of California, an independent fire-testing laboratory.

"U" Factor—The coefficient of heat transfer, "U" is equal to 1 divided by (hence, the reciprocal of) the total of the resistances of the various materials, air spaces and surface air films in an assembly. See Thermal Resistance.

UL—Underwriters Laboratories Inc., founded by NBFU, and now operated in affiliation with AIA. Underwriters is a nonprofit laboratory, operated for the purpose of testing devices, systems and materials as to their relation to life, fire, and casualty hazard in the interest of public safety.

USASI—United States of America Standards Institute, now American National Standards Institute.

Wavelength (Sound)—A wave is one complete cycle of a sound vibration passing through a medium (such as air) from compression through rarefaction and back to compression again. The physical length of this cycle is termed the wavelength. Wavelengths in air vary from about 11⁄16" for a 20,000-cycle per sec. (see Frequency) sound, to approximately 56½ ft. for a 20-cycle per sec. sound—the two approximate extremes of human hearing sensitivity. There are waves outside of this range, but they cannot be heard by humans.

Weep Hole—A small aperture at the base of an exterior wall cavity intended to drain out trapped moisture.

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